Bridge Operations, Policies & Procedures

BOPP 2005

Nebraska Department of Roads
Bridge Division

Introduction

Purpose

The "Bridge Office Policies and Procedures" manual *(BOPP)* is to be used by Nebraska Department of Roads *(NDOR)* Bridge Engineers and Consulting Engineers retained by NDOR. It is intended to assure consistent application of the Bridge department's policies and procedures and to achieve uniformity in the preparation of bridge plans.

Although this manual's purpose is to clarify NDOR bridge design policies and standardize design procedures, it does not preclude justifiable exceptions based on sound engineering principles. All bridge designs are the responsibility of the Bridge Designer and exceptions will be subject to the approval of the State Bridge Engineer.

BOPP Format

The BOPP manual starting with the August 12, 2005 version will be in Adobe PDF format as a single file. Chapter 6 Base Sheets will initially be external and linked to the chapter 6 table of contents. This may change in the future with all chapter 6 pages included in the main BOPP PDF file.

Page Format

All policies are dated with their origination or first publication date in the lower left corner of the page and the revision date, if any, in the lower right corner. In general, shaded text will be used in the revised portion of any policy or procedure to draw the user's attention and to help make them aware of specific policy changes.

Publication and Maintenance

The Bridge Division shall revise this manual as new policies are initiated or when changes are made to existing policies. It is incumbent on BOPP users to incorporate these revisions immediately, as they are required to employ current policies and procedures in all of their designs.

Consulting Engineers are responsible for all policies in effect when the **Notice to Proceed** is issued for a project.

Consulting Engineers shall be notified by mail and/or e-mail when changes to the manual have been made.

All BOPP users should check the Bridge Division website in order to download the latest version of the manual.

The "Bridge Office Policies and Procedures" PDF file can be downloaded from the Nebraska Department of Roads' website at: http://www.dor.state.ne.us/design/bridge/index.htm#bopp

The Consultant should contact the appropriate Assistant Bridge Engineer if there are concerns regarding the changes and their affect on the scope of the project.

If any BOPP user has a revision or addition they wish to propose, they may use the form at the beginning of this manual entitled "Proposed Revision/Addition to the BOPP Manual". The form is self-explanatory and should be submitted to:

State Bridge Engineer
Bridge Division
Nebraska Department of Roads
1500 Hwy 2
Lincoln NE 68509-4759
(402) 479-4701

Proposed Revision/Addition to the BOPP Manual

☐ Revised Document .... *Title* *Page*

☐ New Document

Proposed by: .....

Date: .....

Proposed Revision/Addition: *(Use space provided or attach proposed Revision/Addition to this form.)*

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Reason for Revision/Addition: .....

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Benefit of Revision/Addition: .....

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How will this proposed Revision/Addition affect the overall cost of the bridge?

☐ Increase $ .....

☐ Decrease

☐ No change

☐ Unknown at this time

Will this proposed Revision/Addition deviate from current AASHTO policy?

☐ Yes ..... *Article*

☐ No.

BOPP Manual Chapter Listing

Original Date Published: January 20, 2000

Current Publication: August 12, 2005

Chapter 1
Preliminary Design

SECTION 101 – DATA SHEETS

101.01 - Data Sheet Preparation

Definitions

Critical Berm	The elevation used to determine the minimum design depth of the abutment sheet piles.
Berm Elevation	The level ground elevation at the abutment for the top of the concrete slope protection; or the bottom of riprap. This elevation must be shown on the Front Sheet.
Design Standard	A number that indicates the type of roadway cross section, *(DR1, DR2, DR7)*. Normally, this is based on the vehicle traffic, *(ADT or DHV)*. *(Board of Classifications)*
Freeboard (ft)	The clear distance between low structure elevation and high water elevation.
Minimum Grade (ft)	The lowest point of grade line elevation at the CL Roadway between CL abutments used by the Hydraulic Section for the hydraulic study. Actual grade line profiles for the Bridge Design should use the minimum grade or higher in order to avoid decreasing the free board.
Sufficiency Rating	A rating factor between 1 and 100 that indicates the overall condition of the bridge structure. This factor is used to determine funding of the construction.
TS&L	Preliminary plan showing Type, Size, and Location of the bridge.

General Format

All Data Sheets shall be written using the format of this policy in order to maintain uniformity.

The following two Data Sheet examples should be used as the standard format. Data sheet Example #1, X-X (XXXX), is for a project with an existing structure that will not be removed. Data sheet Example #2, Y-Y (YYYY), is for a project with an existing structure that will be removed.

The amount of information on your Data Sheets is not limited to what is shown on the two examples. You may need to add more information to make your intentions clear. The examples show the minimum information, which must be included. As in the examples, if certain information is not applicable, write N/A, do not delete the heading.

The Assistant Bridge Engineer should review the correspondence file, utility requirements and any other preliminary reports. For existing structures, the Assistant Bridge Engineer should review the Bridge Inventory file.

Weathering Steel Girders

The use of weathering steel should be indicated in the data sheet.

Painting

If any existing structural steel will be painted or removed on the bridge structure, the Assistant Bridge Engineers will be responsible for consulting with Jeff Handeland when the data sheet is being written. The following criteria will be considered:

- Removal of girders, rails, piling, etc.
- Modifying existing girders by drilling or cutting.
- Overcoating and EPA regulations.

101.02 - Data Sheet Example #1

Bridge Design Data Sheet

Project Name

Project No.: X-X (XXX)

Control No.: XXXXXX

Written by: .....

Hydraulics Review by: .....

Approved by:

Lyman Freemon, Bridge Engineer ..... Date .....

Sam Fallaha, Assistant Bridge Engineer ..... Date .....

Lyman Freemon, Bridge Engineer ..... Date .....

(*), Assistant Bridge Engineer ..... Date .....

* Insert name of appropriate Section Leader.

January 4, 2000
Sheet: 1 of 3
By: UR

Project No.: X-X (XXXX)
Control No.: XXXXXX
Structure No.: XXXX XXXXXL
County: Fillmore
Section Location: 10-T13M R13F

Project Name: Example One

Existing Structure: At Sta. 1030+48.00 (RT)

Plan:	XX-X (131)
Year:	1980
Type:	Concrete Slab Bridge
No. of Spans:	3
Bridge Length:	100'-0"
Span Lengths:	29'-9"; 40'-6"; 29'-9"
Width:	39'-0"
Skew:	15° RHB
Sufficiency Rating:	80.0
HS Rating:	20
Low Structure Elev.:	1552.75

Existing structure will remain in place. New structure to be built adjacent to existing.

Proposed New Structure: At Sta. 1030+48.00 (LT)

Clear Roadway:	40 ft.
Type:	Concrete Slab
Live Load:	HS25
Span Lengths:	29'-9"; 40'-6"; 29'-9"
Bridge Length:	100'-0"
Skew:	15° RHB
Curbs:	Open concrete rail
Horizontal Alignment:	Tangent
Design Specifications:	AASHTO Standard, 17th edition

Approach Slabs:

50 ft. standard with 1" preformed joint.

Abutments:

Combination HP pile and sheet pile wall with U-shaped wings.
Critical Berm Elevation = 1536.00 ft
Bottom of sheet piles to extend to at least Elev. 15260.

Bents:

Open pile bents.
Batter end piles 1½" to 12"

Piles:

Bents: HP 12x53 steel piling, XX tons/pile.
Abutments: HP 12x53 steel piling, XX tons/pile.

February 9, 2000 Project No.: X-X (XXXX)
Sheet: 2 of 3 Structure No.: XXX XXXXXL
By: UR

Traffic Data:

Year:	1994	2014
ADT:	2565	4490
DHV:	280	490
% Heavy Trucks:	25	25
Design Standard:		DR-2

Traffic:

Traffic will be maintained on existing bridge during construction of new bridge.

Utilities:

There are no utilities.

Lighting & Sign Structures:

N/A

Note:

New bridge will be twin to existing structure.

Bridge Hydraulic Information:

Stream:	Dry Creek
DA:	21.3 sq. mi.
Q100:	4000 CFS (Design Flood)
WWA below HW:	720 sq. ft.
Q100 General Scour:	0.0 ft.
Q100 Local Scour:	3.0 ft.
HW Elev.:	1543.3 ft. (DS Side)
FL Elev.	1531.8 ft.

Q500 Scour Elev: 1520.0 ft.

Grade:

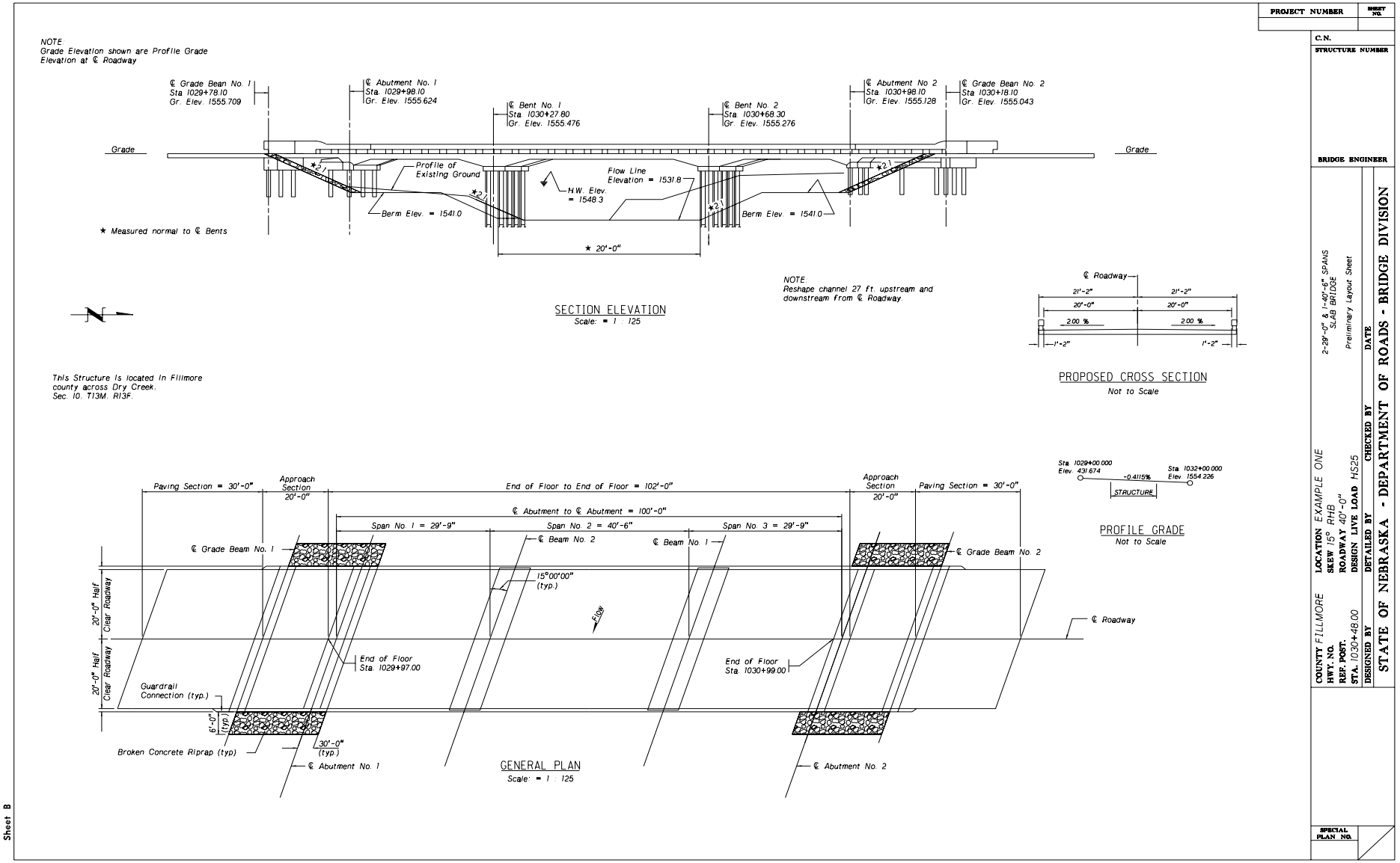
Minimum Bridge Grade:	1555.043 ft.
Crown (+) Superstructure:	1.70 ft.
Low Structure Elev.:	1553.00 ft.
Freeboard Available:	4.70 ft.
Freeboard Required:	1.0 ft.
Grade Raise:	N/A

Channel:

Shape channel and place broken concrete riprap 27 ft. upstream and downstream. See attached Preliminary Layout Sheet.

January 4, 2000
Sheet: 3 of 3
By: UR

Project No. Y-Y(YYYY)
Structure No. YYYY YYYYY



101.03 - Data Sheet Example #2

Bridge Design Data Sheet

Project Name

Project No.: X-X (XXX)

Control No.: XXXXXX

Written by: .....

Hydraulics Review by: .....

Approved by:

Lyman Freemon, Bridge Engineer ..... Date .....

Sam Fallaha, Assistant Bridge Engineer ..... Date .....

Lyman Freemon, Bridge Engineer ..... Date .....

(*), Assistant Bridge Engineer ..... Date .....

* Insert name of appropriate Section Leader.

January 20, 2000
Sheet: 1 of 3
By: UR

Project No.: Y-Y (YYYY)
Structure No.: YYYYYY
County: Fillmore
Section Location: 10-T13M R13F

Project Name: Example Two

Existing Structure:

Plan:	77-2 (131)
Year:	1933
Type:	Concrete Slab Bridge
No. of Spans:	3
Length:	84'-0"
Span Lengths:	25'-0"-34'-0"-25'-0"
Width:	26'-0"
Skew:	20° LHB
Sufficiency Rating:	70.1
HS Rating:	18.1
Low Structure Elev.:	1571.6

Reason for Approval:

Roadway Grade Raise.

Proposed New Structure: At Sta. 438+13

Clear Roadway:	44'-0"
Type:	
Original Design:	Prestressed Concrete Girder NU1600
Alternate Design:	Weathering Steel Welded Plate Girder (60" web depth)
Live Load:	HL-93
Span Lengths:	115'-0"
Bridge Length:	115'-0"
Skew:	20E LHB
Curbs:	Open concrete rail
Horizontal Alignment:	Tangent
Bridge Slab:	Empirical Design
Design Specifications:	2004 LRFD Bridge Design Specifications and interims

Approach Slabs:

50 ft. standard with 1" preformed joint.

Abutments:

Concrete cap on sheet pile wall with U-shaped wings. Use slab turndown.
Critical Berm Elevation = 1561.0 ft.
Bottom of sheet piles to extend to at least Elev. 1547.0.

Bents:

N/A

Piles:

Use HP 12x53 steel piling, XX ton/pile.

January 20, 2000
Sheet: 2 of 3

Project No.: Y-Y (YYYY)
Structure No.: YYYY YYYYYR

Traffic Data:

Year:	1992	2012
ADT:	4430	7025
DHV:	490	775
% Heavy Trucks:	10%	10%
Design Standard:	DR3	

Traffic:

Traffic will be detoured.

Utilities:

There are no utilities.

Lighting & Sign Structures:

N/A

Bridge Hydraulic Information:

Stream:	Ash Hollow Creek
DA:	10.5 sq.mi. (Trib. Flow)
Q100:	4700 CFS (Design Flood)
WWA below HW:	684 sq. ft.
HW Elev:	1565.5 ft. (DS Side)
FL Elev:	1554.5 ft.
Q100 General Scour:	5.0 ft.
Q100 Local Scour:	3.0 ft.
Low Road Elev.:	N/A
Q500 Scour Elev.:	1543.0 ft.

Grade:

Minimum Grade:	1578.1 ft.
Crown (+) Superstructure:	6.44 ft.
Low Structure Elev.:	1571.86 ft.
Freeboard Available:	7.2 ft.
Freeboard Required:	2.0 ft.
Grade Raise:	5.2 ft.

Channel:

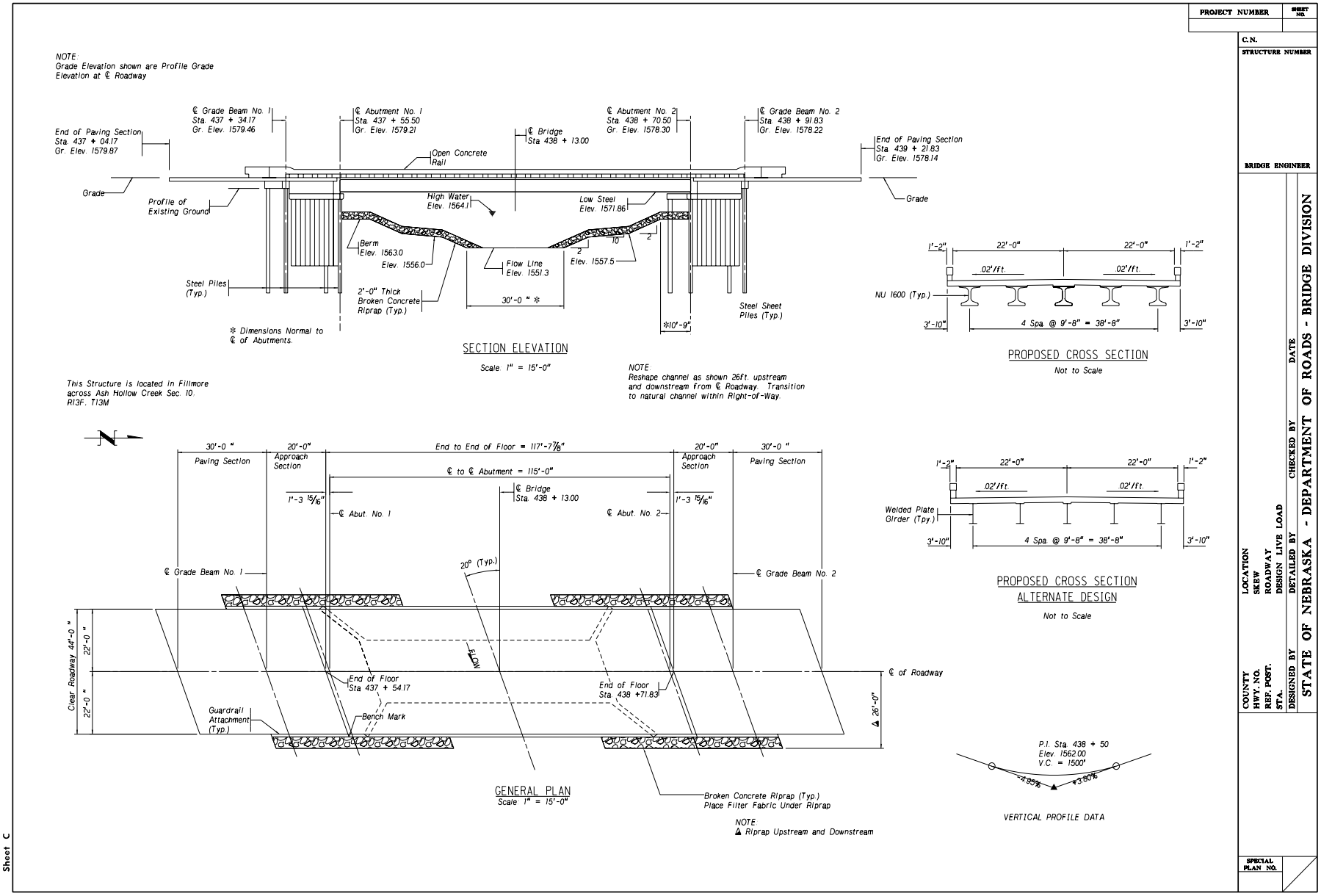
Shape channel and place broken concrete riprap from existing bridge removal 26 ft. upstream and downstream. Transition from graded section to match natural channel. Place filter fabric under riprap. See attached Preliminary Layout Sheet.

Notes:

N/A

January 20, 2000
Sheet: 3 of 3

Project No. Y-Y(YYYY)
Structure No. YYYY YYYYY



SECTION 102 – RAILROAD CROSSINGS

102.01 – Railroad Policy

The information in this policy is based on the Union Pacific Railroad *(UPRR)* and Burlington Northern Santa Fe *(BNSP)* Drawings and written correspondence with both companies.

Plan Submittals to Railroad (RR)

Preliminary Design

When the preliminary layout *(TS&L -Type, Size & Location)* has been determined, the TS&L will be submitted to the railroad liaison for approval. The submittal should include a Plan View, an Elevation View showing the layout criteria, bridge cross-section and for UPRR only an overhead submittal checklist.

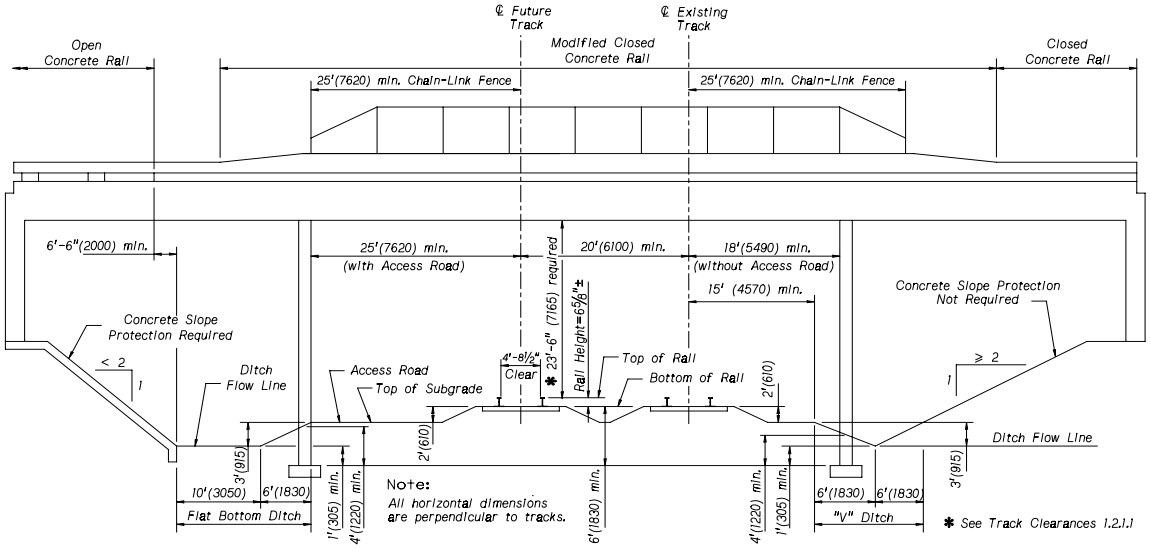
Final Design

Final Plans *(4 copies)* shall be submitted to the railroad liaison for approval.

For metric projects, the equivalent English dimensions for every item on the overhead submittal checklist shall be written in parenthesis next to the metric dimensions. See UPRR overhead submittal checklist Page 15 and Page 16.

Layout Criteria

The following sketch illustrates the general layout criteria for UPRR & BNSF.



LAYOUT SKETCH

Concrete Slope Protection

Concrete slope protection shall be provided for slopes steeper than 1 vertical to 2 horizontal. The Assistant Bridge Engineer will determine the type of slope protection for slopes less than or equal to 1 vertical to 2 horizontal.

Future Tracks

UPRR or BNSF may require space be provided for additional future tracks or access roads. Additional clearance may be required for future adjustments in track sag or vertical curve or if future track may be changed for flood considerations. This information should be obtained by the Bridge Division through the Railroad Liaison from UPRR or BNSF before the TS&L stage of planning.

Note: For future tracks, the horizontal spacing between two tracks measured at right angle from centerline of tracks shall be 20 ft for UPRR and 25 ft for BNSF.

Track Profiles

- When vertical clearances are less than 24'-0", surveys for the profile of the existing top of rail 1000 ft. each side of the proposed structure need to be performed only on one rail for each mainline track and shall be shown on both the preliminary and final submittals to the railroad. Profile to be done by Roadway Design.
- A profile is not needed for industrial tracks.
- The low rail *(in a curve)* shall be used for the profile. In straight-through tracks, the right rail shall be used. The right rail is defined as the rail on the right side of the track when looking towards increasing railroad milepost number. Railroad milepost numbers usually increase from South to North and East to West, designers need to verify the direction of milepost numbers increase with the railroad liaison.
- Profiles are to be superimposed together onto one sheet.

The following note *(Note #660)* shall be placed on the final bridge design plans:

> The top of rail elevations shall be verified in the field before beginning construction of the bridge. If the rail elevations are not as shown on the plans, the Project Manager shall contact the Bridge Division.

Track Clearances

- The required vertical clearances shall be 23'-6" above the plane of the top-of-rails. If the required vertical clearances cannot be met, designers can use a minimum of 23'-0" with the Assistant Bridge Engineer approval. Separate shots shall be taken from the high rail(s) to measure vertical clearance and shall be shown on the TS&Ls.
- Horizontal clearances are measured perpendicular to the CL of tracks from CL of track to the face of column or wall.
- Where provision is made for more than 2 tracks, space is to be provided for access roads on both sides of the track.
- Required horizontal clearances are to be increased 1½" per degree of curve where the structure is located adjacent to or within 80' of the curve limits.

Construction Clearances

Minimum construction clearances shall be as follows:

- 21'-0" for UPRR & 21'-6" for BNSF, vertical above the plane of top-of-rails.
- 12'-0" for UPRR & 15'-0" for BNSF, horizontal at right angle from centerline of track.

Drainage

Drainage from the overpass must be diverted away from the Railroad tracks and not discharged onto the tracks or roadbed. The direction of drainage flow will be shown on the Plans *(consult with the Assistant Bridge Engineer and Roadway Designer).* Drainage at the abutments or approach slabs will be diverted perpendicular to the roadway and flow to the roadway ditch, in coordination with the roadway designer.

A "V"-shape or flat-bottom ditch will be provided on each side of the tracks to match the existing ground or as required by the RR company. Culverts may be installed on the opposite side of the pier from the track in lieu of ditches when approved by the railroad's Chief Engineer Design.

- Bridge Deck Drainage

  When floor drains are required, a flat bottom ditch will be required by the railroad to carry any increased drainage from the embankment slope. The Bridge Designer will take the necessary precaution to minimize erosion and prevent erosion deposits from building up in the ditch. This will interfere with the proper track ballast drainage and lead to settlement of the tracks.

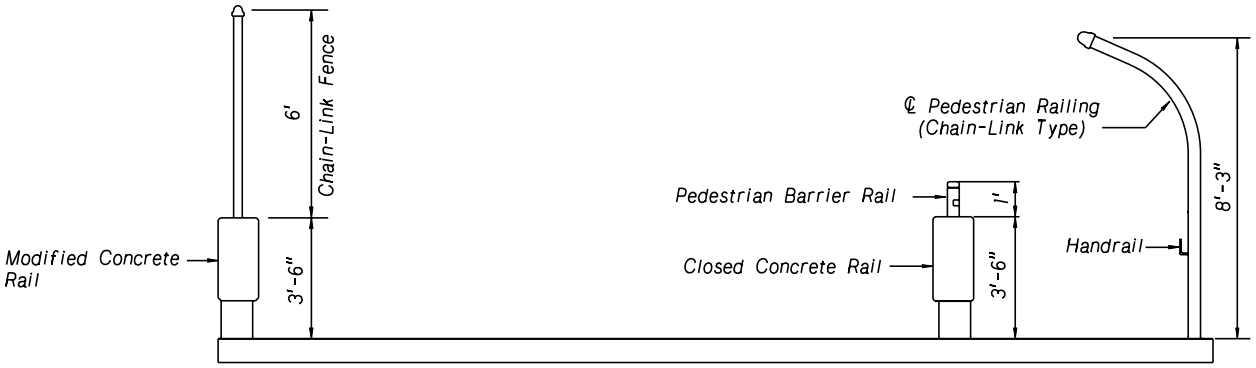
Railroad Barriers

Bridges without sidewalks

BNSF: Roadway fence may be required at certain locations. As a minimum, a 3'-6" high modified concrete rail shall be provided over the railroad tracks.

UPRR: A 3'-6" high modified concrete rail with a chain link fence extending 9'-6" above the bridge deck is required over the railroad tracks. See railroad base sheets in Chapter 6.

In locations where switching or other frequent railroad activities are performed, Union Pacific and Burlington Northern Santa Fe may have additional special requirements.



TYPICAL SECTION with SIDEWALK

Footings

The top of the footings will be a minimum of 6'-0" below the base of the track rail, 4'-0" below the natural ground, and a minimum of 1'-0" below flow line of ditches.

Lighting

Lights are to be installed on the underside of the viaduct for bridges over 80' in width.

Pier Protection

Pier protection *(crash walls)* shall be provided in accordance with the Manual for Railway Engineering, which reads as follows:

Pier Protection

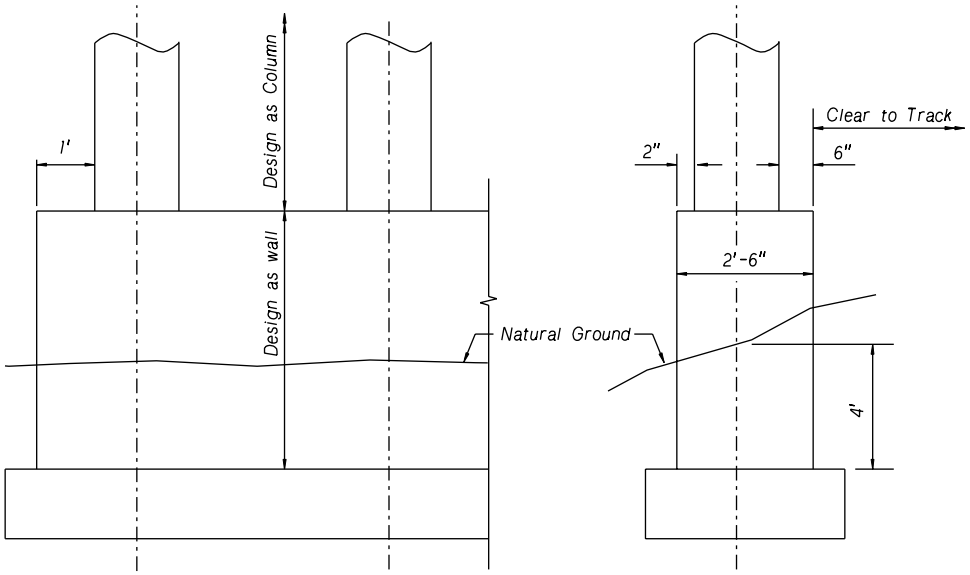
Adjacent to Railroad Tracks

To limit damage by the redirection and deflection of railroad equipment, piers supporting bridges over railways and with a clear distance of less than 25 feet from the centerline of a railroad track shall be of heavy construction *(defined below)* or shall be protected by a reinforced concrete crash wall. Crash walls for piers from 12 to 25 feet clear from the centerline of track shall have a minimum height of 6 feet above the top of rail. Piers less than 12 feet clear from the centerline of track shall have a minimum crash wall height of 12 feet above the top of rail.

The crash wall shall be at least 2 feet 6 inches thick and at least 12 feet long. When two or more columns compose a pier, the crash wall shall connect the columns and extend at least 1 foot beyond the outermost columns parallel to the track. The crash wall shall be anchored to the footings and columns, if applicable, with adequate reinforcing steel and shall extend to at least 4 feet below the lowest surrounding grade.

Piers shall be considered of heavy construction if they have a cross-sectional area equal to or greater than that required for the crash wall and the larger of its dimensions is parallel to the track.

Consideration may be given to providing protection for bridge piers over 25 feet from the centerline of track as conditions warrant. In making this determination, account shall be taken of such factors as horizontal and vertical alignment of the track, embankment height, and an assessment of the consequences of serious damage in the case of a collision.



Note: When drilled shafts are used in lieu of footings, the crash wall shall be anchored to the columns with adequate reinforcing steel and shall extend to at least 1 foot below the lowest surrounding grade.

Overhead Submittal Checklist

Project Information **Hwy/Street Name:** **City and State:** **County/Parish:** **Project No.:** **Date:**	**File:** **Grade Separation** **State: Location:** **Street/Hwy:** **Rte: M.P.: Sub:** **DOT No.:** **AWO:**

Item	Required Information	Min. Req'd.	As Submitted	Railroad Remarks A=Approved R=Rejected	
				AR	
	Abutment or Bent #				
1	Horizontal Clearance (left) (CL to face)	18'-0"			Left side by direction of RR Mileposts
2	Horizontal Clearance (right) (CL to face)	18'-0"			Right side by direction of RR Mileposts
3	Vertical clearance (from top of rail)	23'-0"			Top of rail to lowest clearance in first span
***4**	Horizontal clearance to footing from CL track	25'-0"			Edge of footing to Center of Track
***5**	Depth top of footing below base of rail	6'-0"			Top of footing to base of rail (8" below top rail)
6	Pier protection required for <25'	25'-0"			Crash wall if face of pier less than 25' to center
7	Shoring required (CL to nearest Pt.)	12'-0"			No shoring closer than 12' to center track
	Bent #				
1	Horizontal Clearance (left) (CL to face)	18'-0"			
2	Horizontal Clearance (right) (CL to face)	18'-0"			
3	Vertical clearance (from top of rail)	23'-0"			
***4**	Horizontal clearance to footing from CL track	25'-0"			
***5**	Depth top of footing below base of rail	6'-0"			
6	Pier protection required for <25'	25'-0"			
7	Shoring required (CL to nearest Pt.)	12'-0"			
	Bent #				
1	Horizontal Clearance (left) (CL to face)	18'-0"			
2	Horizontal Clearance (right) (CL to face)	18'-0"			
3	Vertical clearance (from top of rail)	23'-0"			
***4**	Horizontal clearance to footing from CL track	25'-0"			
***5**	Depth top of footing below base of rail	26'-0"			
6	Pier protection required for <25'	25'-0"			
7	Shoring required (CL to nearest Pt.)	12'-0"			
	Bent #				
1	Horizontal Clearance (left) (CL to face)	18'-0"			
2	Horizontal Clearance (right) (CL to face)	18'-0"			
3	Vertical clearance (from top of rail)	23'-0"			
***4**	Horizontal clearance to footing from CL track	25'-0"			
***5**	Depth top of footing below base of rail	6'-0"			
6	Pier protection required for <25'	25'-0"			
7	Shoring required (CL to nearest Pt.)	12'-0"			

* If the horizontal clearance (4) to footing from CL track is less than 25'-0", then the top of footing (5) must be at least 6' below base of rail.

Overhead Submittal Checklist

Item	Required Information	Min. Req'd.	As Submt'd.	Railroad Remarks A=Approved R=Rejected	
				AR	
	Track Requirement				
1	Existing track center	Required			Measure maximum track centers at bridge width
2	Track spreading taken into consideration	Required			Yes or No
3	Future track centers	20'-0"			RR to advise spread or future tracks
	Safety Requirements				
1	Splashboards or barrier rail Near Side (NS)	5'-0"/3'-6"			Near side is by direction of RR Milepost
2	Splashboards Far Side (FS)	25'-0"			Far side is by direction of RR Milepost
3	Splashboards limits adequate	R/W to R/W			25' minimum past center of outside tracks
4	Fence (w/ pedestrian walkway) (NS or FS)	8'-0" to 10'-0"			Near Side or Far Side, Ped. walk
5	Fence (w/o pedestrian walkway) (NS or FS)	10'-0"			Near Side or Far Side, without Ped. walk
6	Fence limits adequate	R/W to R/W			25' minimum past center of outside tracks
	Drainage Requirements				
1	Adequate drainage (left)	Required			Left of tracks by RR Milepost
2	Adequate drainage (right)	Required			Right of tracks by RR Milepost
3	Drain from Str./Leaders at Bents				Show drainage on structure to-off RR right of way
	General Requirements				
1	Access road (25' from CL to face)	25'-0"			Existing road, or RR to advise proposed road(s)
2	RR R/W shows correctly	Required			Railroad right of way lines shown
3	All tracks labeled correctly	Required			Each track labeled, RR to furnish
4	Existing utilities aerial or underground	Required			By State
5	Maximum gap between structures	2'-0"			For no fence or higher barrier rail if 2' or less
6	Lights required for width of structures over 80'	80'-0"			Min. 10' between structures, check for activities
7	Track profile for 1000' on each side of str.	1000'			Can be visually inspected, if needed, by MTM
8	Demolition required				Comply with UP requirements by contractor
9	Abutment slope protection	>2:1			
10	Temp. Construction vertical clearance	21'-0"			Note on plans
11	Temp. Construction horizontal clearance	12'-0"			Note on plans
12	Milepost number & direction of increase	Required			RR to provide direction, State to provide location
13					
14					
15					

Instructions:

Milepost and direction of Milepost must be shown in the plans. Left and Right are the orientation of structure elements facing in the direction of increase milepost.

Fill all applicable parts of Table above: In Column "As Submitted" Insert all Applicable Values from Plans.

For any exception to the minimum requirements on the checklist, a detailed explanation/reason why the minimum requirements cannot be provided.

Preliminary Plan Review:

If items on the above table show deficiencies, acceptance of preliminary plans will not be granted until deficiencies are resolved.

Final Plan Review:

Before Structure Construction Signed Final Plans, Special Provisions, and Hydraulic Calculations, if required, shall be submitted for final review. If all items are resolved and plans comply, will release structure for construction.

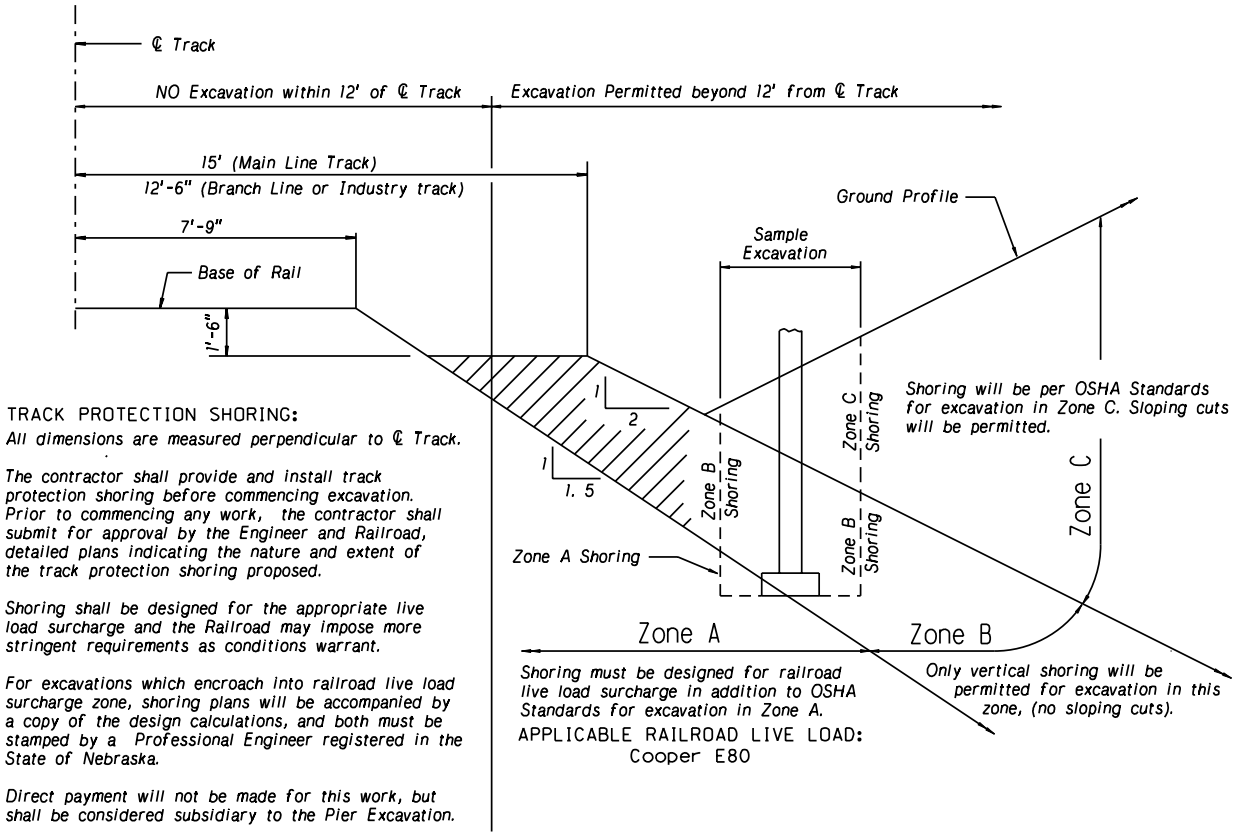
Units:

Units for the above checklist to be in English.

102.02 - Railroad Track Protection Shoring

Excavations more than 12'-0" from CL Track

In most Railroad viaducts, shoring shall not be allowed within 12'-0" of CL track. The following cell AC=UPSHR1 shows RR shoring requirements. Designers should show railroad shoring requirements, therefore, base sheet 605.13 should be included in the bridge plans.



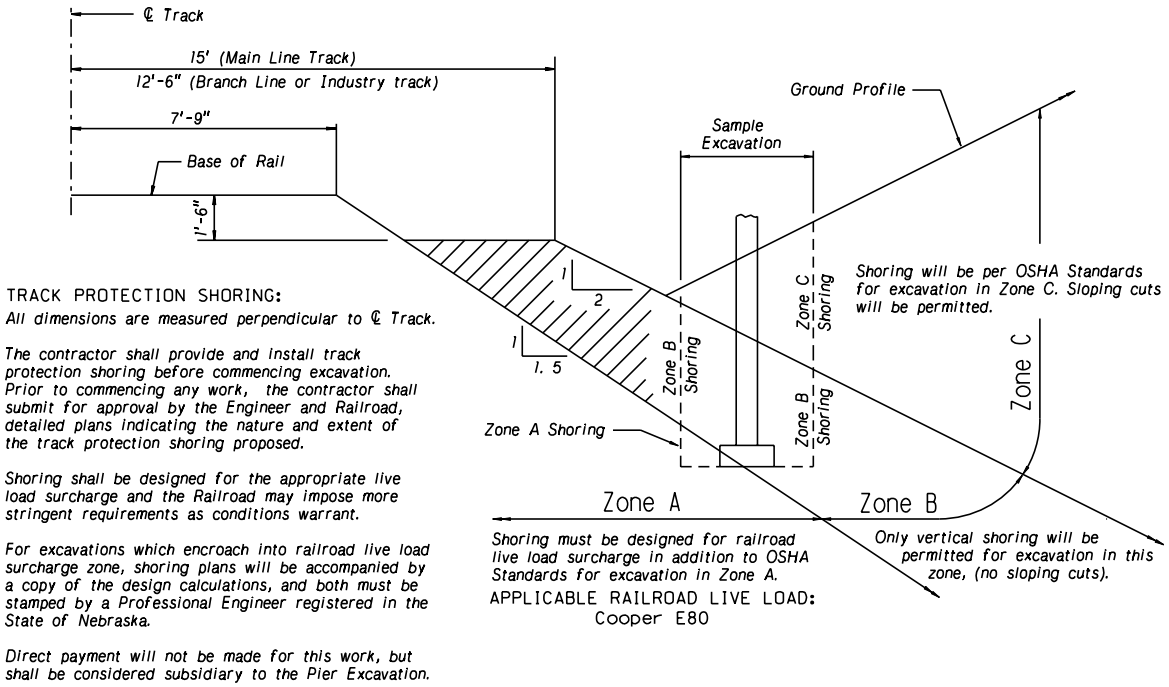
TRACK PROTECTION SHORING REQUIREMENTS

Excavations less than 12'-0" from CL Track

In situations when the railroad company agrees to an exception and determines that the track can be taken out of service during construction, the following cell AC=UPSHR2 shows railroad requirements. Permission for an exception should be obtained from the Railroad Company at the TS&L *(Type, Size, & Location)* stage of planning.

Excavations less than 12'-0" from CL Track (continued)

Designers should show railroad shoring requirements, therefore, base sheet 6.5.13 should be included in bridge plans.



TRACK PROTECTION SHORING:

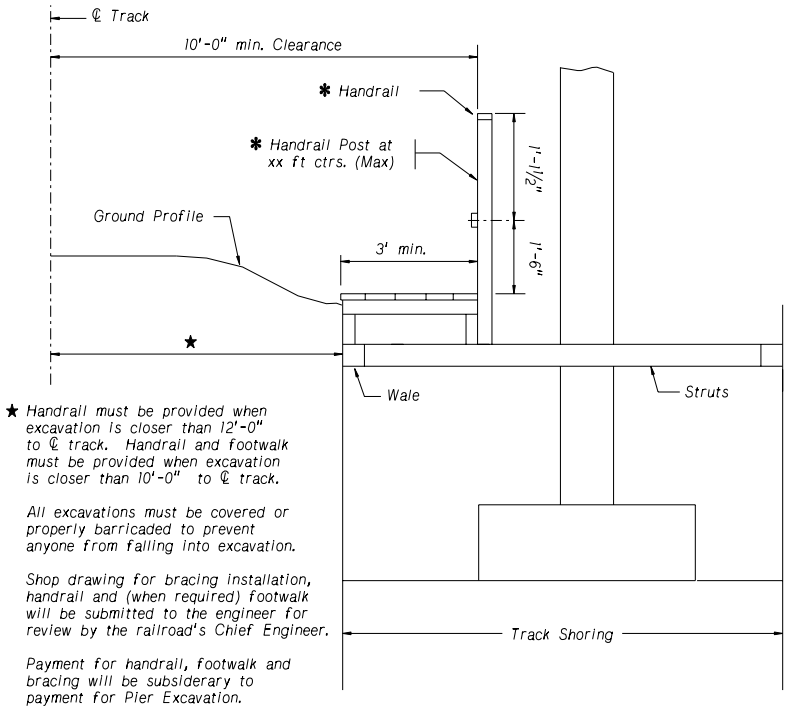
All dimensions are measured perpendicular to ℄ Track.

The contractor shall provide and install track protection shoring before commencing excavation. Prior to commencing any work, the contractor shall submit for approval by the Engineer and Railroad, detailed plans indicating the nature and extent of the track protection shoring proposed.

Shoring shall be designed for the appropriate live load surcharge and the Railroad may impose more stringent requirements as conditions warrant.

For excavations which encroach into railroad live load surcharge zone, shoring plans will be accompanied by a copy of the design calculations, and both must be stamped by a Professional Engineer registered in the State of Nebraska.

Direct payment will not be made for this work, but shall be considered subsidiary to the Pier Excavation.



★ *Handrail must be provided when excavation is closer than 12'-0" to ℄ track. Handrail and footwalk must be provided when excavation is closer than 10'-0" to ℄ track.*

All excavations must be covered or properly barricaded to prevent anyone from falling into excavation.

Shop drawing for bracing installation, handrail and (when required) footwalk will be submitted to the engineer for review by the railroad's Chief Engineer.

Payment for handrail, footwalk and bracing will be subsiderary to payment for Pier Excavation.

✱ *Handrail size and Handrail Post size & spacing shall conform to OSHA requirements.*

TRACK PROTECTION SHORING REQUIREMENTS

SECTION 103 – HISTORIC BRIDGES

103.01 - Historic Bridge Management

Background

In compliance with the Section 106 of the National Historic Preservation Act which declares that any project involving federal funds must take into consideration the impact that the project might have on properties eligible for, or listed on the National Register of Historic Places. Since federal funds are often involved in aid to highway and road improvements in Nebraska, the provisions of Section 106 apply to most highways and many county bridges in the state.

Responsibility for administering Section 106 rests with Nebraska State Historical Preservation Office *(SHPO)*, and when federal funds are involved, negotiation is conducted between the FHWA and the SHPO to verify resource consideration and protection. Even if federal funds are not involved in a project, it is good stewardship of these important historic resources to preserve them for future generations.

In addition, Section 4(f) of the U.S. Department of Transportation Act protects historic sites from highway project effects unless there is “no feasible and prudent alternative”. If the project cannot avoid affecting a historic property, the project must be planned to minimize the damage. The Surface Transportation and Uniform Relocation Assistance Act of 1987 goes further. Asserting that it is “in the national interest to encourage the rehabilitation, reuse, and preservation of bridges significant in American history, architecture, engineering, and culture”. The Act permits the federal government to reimburse costs associated with preserving historic bridges or mitigating unavoidable damage.

Priorities for Treatment of Historic Bridges

1. The preferred treatment for a historic bridge is to have it continue to carry vehicular traffic at its original site with minimal modification.
2. If it is not feasible to keep the bridge at its original site, every effort should be made to find an appropriate site to which it could be relocated for vehicle use. There is a marketing and advertising requirement in the Agreement between the FHWA, NDOR, and the SHPO to notify the public and other government entities of the availability of the bridge for reuse.
3. If the bridge can no longer carry vehicular traffic, or could do so only at the expense of its historic integrity, the next best solution to evaluate is nonvehicular use at its original site with minimal modification *(e.g.; pedestrian or bike bridge)*.
4. If the bridge can no longer carry vehicular traffic, no “as is” use is feasible, or it cannot be left in place, adaptive uses should be evaluated, with preference given to reuse that retains the bridge at its original location. If no suitable in-situ adaptive use can be found, the bridge can be relocated to a less demanding vehicular crossing or adapted for nonvehicular use at the new location *(preferably in the public domain).*
5. If the bridge cannot remain at its original site and cannot be moved, it shall be documented to the standards of the Historic American Engineering Record before demolition, disassembly, or modifications that will destroy its historic integrity. If possible, the structure should be disassembled carefully and stored until a new location for it can be found or significant components should be incorporated into any new bridge at the site or salvaged for educational purposes.

Alternative Evaluation and Documentation – A Requirement

When a project will affect a historic bridge, the FHWA and the State Historic Preservation Officer will judge whether the project will adversely affect the structure, and whether adequate alternative evaluation have been conducted to avoid or minimize the effect. It is the responsibility of the NDOR and/or the county to provide a report containing a full description of all alternatives considered, to avoid, minimize or mitigate affects to the structure. *(Example of such analysis is available upon request from NDOR).* When documenting the need for replacing or preserving a bridge, technical, legal, financial, and safety considerations must be weighed in reaching the final decision. The problem with the structure must be clearly stated, be it structural or functional.

The following range of alternatives *(listed by priority)* must be considered carefully before plans to alter or remove a historic bridge are finalized.

1. **Continued use of the bridge for vehicle traffic at its original location, with restoration and rehabilitation.**
   - Passive, non-structural actions to lower the live load on a bridge should be considered as a first alternative when load is of concern. Lowering the posted load limit and restricting traffic to one direction are examples of ways to retain a bridge in service without structural modification.
2. **Use of the bridge for non-vehicular traffic at the site.**
   - Issues involved with this option include what to do with vehicular traffic. This may be a considerable problem at an important crossing when there are no alternate bridges convenient or capable of handling greater traffic loads.
   - It may also be problematic if physical or economic considerations require use of the existing bridge site for a new bridge.
   - One alternative that has been used is to build a new bridge alongside the old one, altering alignment to properly accommodate the new location.
   - The existing bridge may be closed to vehicular traffic, but is reserved in place for public viewing.
   - Some counties have been provided historical markers and hiker/biker pathways to display the bridge.
   - One suggestion has been made that the bridge can be retained for vehicle crossing if it meets structural sufficiency, so that the traveling public can experience driving over the old bridge if they so choose.
   - Every effort should be made to keep the bridge in public ownership, either through continued use by the current owner or another government agency.
   - If marketing of the bridge to private ownership is necessary, protective covenants must be put in place for the bridge's preservation.

3. **Relocation of the bridge.**
   - When a bridge must be moved to a new site, provisions must be made for maintenance, damage protection *(natural and manmade)*, and public accessibility.
   - The abutments or piers at the new site should match the original configuration, if possible.
   - Issues of ownership and marketing, as described above, must be considered.
4. **Destruction of historic character, demolition.**
   - This option includes rehabilitation without consideration of historic integrity. Work that harms the historic integrity of the bridge should be undertaken only if it is not possible to make the bridge safe and efficient and it cannot be moved.
   - In this event, the bridge shall be documented for the Historic American Engineering Record prior to the onset of work, unless an emergency situation exists.
   - If demolition is to occur, significant and ornamental features should be salvaged and reused to assist the preservation of a similar structure or for educational purposes, or should be mothballed for reuse in the future.

The information presented herein is offered to assist early evaluation of alternatives for historic bridge preservation. The Nebraska Department of Roads offers assistance in this process through our Historic Bridge Program Office. If federal funding is to be used in the proposed project, its availability will be dependent upon proper completion of the paperwork and processes described in this document. For additional information or assistance, please contact Environmental Section Manager *(currently Cynthia Veys, phone (402) 479-4410).*

Maintenance Activities on Historical Bridges

The following repairs and bridge maintenance, necessary to keep the bridge functioning, will not change the appearance or character of a bridge.

1. Bridge deck patching or placing of concrete overlay.
2. Replacing of truss or other structural members in kind.
3. Replacing bridge rail.
4. Painting of structural steel or railing.
5. Redecking or replacing curbs.
6. Rebuilding of abutment or pier caps.
7. Replacing of bearing devices in kind.
8. Replacing of bridge expansion or fixed devices.
9. Backfilling erosion around abutments.
10. Providing scour protection at piers or abutments.
11. Providing additional bracing to bents.
12. Reestablishing berm, as needed.
13. Repairing collision damage, as needed.

Chapter 2
General Bridge Design

SECTION 201: GENERAL PLAN ITEMS

201.01 - Bridge Plan Procedures Policy

Data Sheet

A data sheet will be prepared as prescribed in the *Data Sheet Preparation* policy.

Design

All Bridge Plans shall be designed or checked for structural integrity by an experienced engineer, registered by the State of Nebraska.

Plan Sheets

Plan sheets should be assembled in the order of construction and include the plan items listed below. Phasing or large scale projects may require more than one sheet to properly detail plan items.

- Cover Sheet
- Front Sheet
- Geology Sheet
- Abutment Sheet
- Pier/Bent Sheet
- Girder Sheet
- Roadway X-Section Sheet
- Concrete Rail/Barrier Sheet
- Approach Slab Sheet
- Bill of Bar Sheet

Rating

All superstructures *(state and county projects)* shall be rated well ahead of the turn-in-date. Superstructure sheets should be submitted for rating as soon as the design is completed. Consultants shall supply the required information to the Rating Section at **first review**. The intent is for the superstructure to be evaluated by the Rating Section while the designer continues with the substructure design.

Assistant Bridge Engineer Review

After a design check is completed and the Bridge plans are detailed, the Assistant Bridge Engineer will review the plans. When applicable, a set of prints will be transmitted to the railroad office.

Two *(2)* sets of quantity calculations must be prepared after all review comments have been resolved and/or incorporated into the plan.

Turn-in

Structure numbers can change from the time the preliminary data sheet is written to the time the project is turned in. Structure numbers need to be verified on CICS1 before the project is turned in; especially on new alignments.

The Assistant Bridge Engineer shall prepare special provisions for work and/or pay items not covered by the Standard Specifications. Items such as “Preparation” or “Removal” will need to be written to meet the individual structure requirements. Other standardized “special provisions” are available on tape from the Information Processing Center, and published in Chapter 5 of the BOPP manual.

The Assistant Bridge Engineer shall prepare a Bridge quantity summary using the Trans.Port Letting and Award System *(LAS)* computer program.

Turn-in *(continued)*

The Assistant Bridge Engineer shall transmit the Bridge plan originals, special provisions, and a copy of the quantity summary to the appropriate Roadway Design Section Leader or the Secondary Roads Engineer.

The Assistant Bridge Engineer, Bridge Designer, or consultant shall sign and date their stamp on each sheet of the bridge plans. The Geology sheets and the Pile Layout sheets shall also be stamped, signed, and dated by the Geotechnical Engineer. The stamp of the Assistant Bridge Engineer, Bridge Designer, or Consultant shall be placed in the title block. The Geotechnical Engineer's stamp shall be placed outside the title block adjacent to the P.E. stamp in the title block.

Before the originals leave the Bridge office, one set of prints shall be produced, marked, and dated as "Letting Prints" and filed by project number.

Project Letting

After the project has been let, a 1/2 size of paper print will be filed by project number. *(All alternate designs may be discarded at this time.)* Full size originals and shop plans are filed by project number in the vault.

Completed Project

As-built plans are provided by the Construction office after the construction is complete. All as-built modifications are transferred to the full-size original plans and then sent to archives, with the shop plans, to be microfilmed by structure number. Shop plans and the full-size originals are destroyed, unless they are a special structures*. As-built plans are then sent to the Planning Division, which in turn sends them to the District in charge of the project for storage.

* Special structures include:

(1) Missouri River Bridges

(2) Detour or temporary Bridges

(3) All Bridges on Interstate 480, 680, 180 & 129

(4) All Bridges 500' long or longer

201.02 - Design Documentation

General

The intent of this policy is to establish uniformity in compiling design calculations.

In order to maintain effective Bridge Division archives for future use, design calculations should be properly identified and assembled so that important information can be retrieved with relative ease.

In the event a single page becomes separated from the package, every page of your design, including calculations, sketches or notes, shall be identified using the basic information shown below.

Sample Page

	PROJ. LOC. *Doors Creek*	PROJ. NO.	*F-7-4(1002)*
		STATION	*629+52*
STATE OF NEBRASKA	COUNTY *Small*	DATE	*5-4-93*
DEPARTMENT OF ROADS		BY	*U.R.*
Trustworthy BRIDGE DIVISION		STRUCTURE	*S007*
02395 SHEET *31* OF *54*			

Design Calculation Outline

Preliminary Data

1. Preliminary Data Sheet
2. Data Sheet
3. Notes from Correspondence & Hydraulics Files
4. Notes from Roadway Design Discussions
5. Notes from Geology
6. Typical Cross Section
7. Plan and Profile Grade
8. Horizontal and Vertical Alignment

Superstructure

1. Loads
2. Concrete Slab Design
   - Reinforcing Steel Typical Section
3. Girder Design
4. Expansion Joint Calculations
5. Bearing Devices
6. Girder Seat Elevations
   - Piers/Bents
   - Abutments

Substructure

1. Loads on Substructure
   - Piers/Bents
   - Abutments
2. Pier/Bent Design
   - Cap and Pedestal Dimensions
   - Flexural Reinforcing Steel
   - Shear Reinforcing Steel
   - Wall or Column Design
   - Footing Design
   - Pile Design
3. Abutment Design
   - Cap and Bearing Dimensions
   - Abutment Beam Design
   - Wing Design
   - Abutment and Wing Pile Design
   - Sheet Pile Design

Rail Dimensions
Approach Slab Design
Shim Information

201.03 - Plan Title Block Policy

General

Bridge Division plans must have the following items contained in the title block on each sheet.

Project Number
Control Number
Structure Number
Bridge Engineer's Seal
County Name
Highway Number
Reference Post
CL Bridge Station
Location
Skew
Roadway Width
Design Live Load
Bridge Description
Designer
Detailer
Checker
Date
Nebraska Logo
Engineer's Seal/Date
Special Plan Number

Consultant Plans

Consultants will place their logo in the lower right-hand corner of the plans outside the title block provided by the Bridge Division on State and County Bridge plans they design.

Project Number

The purpose of project numbering is to provide a numbering system for highway construction projects. For example, projects on the state highway system are numbered using a prefix *(one to ten letters)* indicates the highway system, the highway number, zone and sequential number *(in parenthesis),* such as NH-2-3(112).

Project Number may change if there is a highway system change or funding change for the project *(Federal to State funds).*

The Bridge Division policy is to omit lettering that indicates funding *(before the project number)* on all Bridge plan sheets.

Control Number

Control Number is a 7 position field that uses a 5 position number assigned to a project based upon the district in which the project is located and will not change during the life of the project. The first number of the Control Number stands for the District in which the project is located, the remaining numbers are sequential.

Structure Number

The following format must be used for structure numbers:

County Bridges – STRUCTURE NO. XXXXXXXXXX	Example: C002004305
State system Bridges – STRUCTURE NO. XXXX XXXXX	Example: S077 12668

State system structure numbers consist of the highway number and reference post number. The first one or two characters will be a letter designating the type of road. *("S" = state, "C" = county, "U" = urban, "M" = municipal, "SS" = state spur, "SL" – state link, "SR" = state recreation.)* The next three or four characters designate the location by county, city, or highway number. The next five numbers indicate the reference post, which is unique to the Bridge, and give its exact location. Except for links and spurs, most reference posts increase from West to East and South to North. The very last character is usually left blank. In the case of twin structures, an "L" or "R" may appear as a letter on the end to designate right or left structure. The letter "P" may also be used as the last character and indicates a county Bridge not on a section line. Other letters may be used to designate ramp structures at interchanges. If a structure number has a reference post with a letter on the end, then the letter must be included with the reference post in the title block. If information on Bridge plans sheets applies to both a Left and a Right structure, then add "L & R" to the end of the structure number, *(S077 12668L&R)*.

Twin Structure
Generally, twin structures have concrete barriers that are separated by a large or small distance, regardless of whether or not the abutments or piers are common to both structures.

Single Structure
Generally, single structures have a 6" median curb or solid median barrier separating lanes of traffic. In other words, the superstructure is one piece.

CL Bridge Station

The station at the midpoint along the CL roadway between the two abutments. Twin structures shall use the midpoint station along the CL project.

Location

Location is equivalent to the old item, "State Road" which is normally the Project Name.

Skew

In general, if all supports are not parallel, then the skew shown in the title block will indicate "VARIES".

Straight Alignments: The angle between the CL of supports and a line perpendicular to the CL roadway.

Curved Alignments: The angle between the CL of supports and a line perpendicular to the chord line, based off the CL roadway.

Curved Twin Structures: The angle between the CL of supports and a line perpendicular to the chord line, based off the CL project. The chord line is from CL abutment to CL abutment.

Sheet Description

Sheet description should indicate the type of items shown on the sheet and should match the plan sheet index shown on the cover sheet.

Special Plan Number

Each Bridge design, including alternates, shall have a unique special plan number starting with 1, 2, 3, etc. for Bridges with the same project number. Identical twin structures that have one Bridge plan for two structures would be the only exception.

Bridge Description

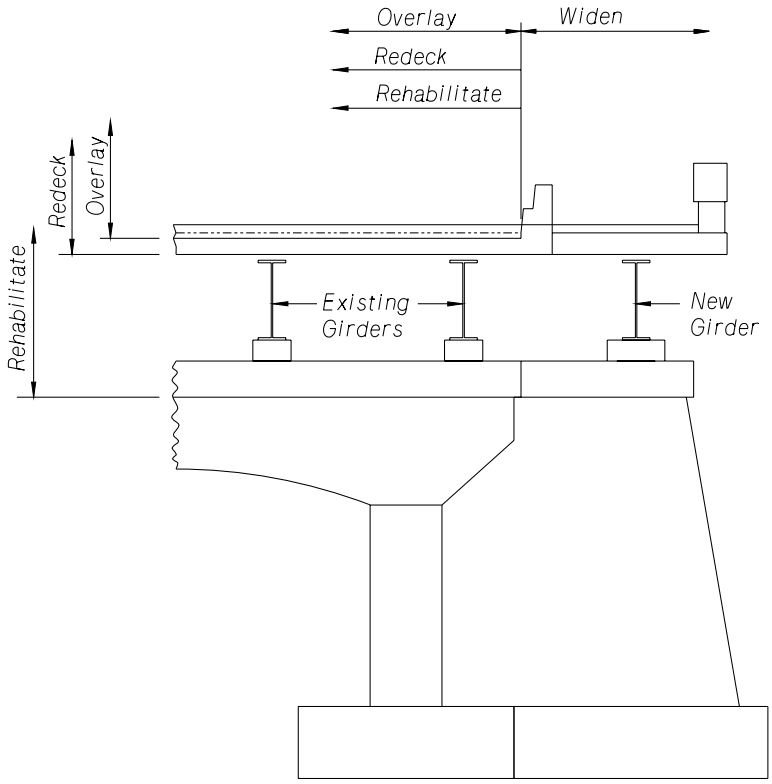
The Bridge description includes the following three types of information:

1. **Span description**
   Length of Bridge from CL abutment to CL abutment and number of spans
   Use the format, XXX-XX" X-Span
   Examples:
   100'-0" SIMPLE SPAN
   200'-0" 2-SPAN
   300'-0" 3-SPAN

2. **Bridge type**
   CONCRETE SLAB BRIDGE
   ROLLED BEAM GIRDER BRIDGE
   WELDED PLATE GIRDER BRIDGE
   PRESTRESSED GIRDER BRIDGE (NU XXXX)
   PRESTRESSED DOUBLE TEE BRIDGE (XX.X" depth)

3. **Description of work** *(See sketch on the following page)*
   WIDEN — Addition of a section of Bridge that makes the Bridge wider but the existing deck remains. This may include widening the existing substructure and/or adding a line of girders.

WIDEN & OVERLAY	Addition of a section of Bridge that makes the Bridge wider and places an overlay on the existing deck.
WIDEN & REDECK	Addition of a section of Bridge that makes the Bridge wider and replacement of the existing deck.
WIDEN & REHAB	Addition of a section of Bridge that makes the Bridge wider and replacement of the all or part of the existing girders. This can include repairs to the existing substructure.
REDECK	Replacement of the existing deck at approximately the same roadway width.
REHAB	Replacement of the existing deck and superstructure. This can include repairs to the existing substructure. Examples include: lengthening, converting simple spans, or hanger pins to continuous design.
NEW STRUCTURE	A completely new Bridge without any parts of the previous structure. This description shall not be indicated in the title block.



DESCRIPTION OF BRIDGE WORK

SKETCH

201.04 - Cover and Front Sheet Policy

The first sheet in the Bridge plans must be a Cover Sheet that shows: General Notes, Quantities, and a Plan Sheet Index. When Standard Plans are used in the Bridge plans, a reference to the Standard must be shown in the lower right corner of the cover sheet. *(See concrete piling in the Bearing Piles Policy.)*

The following items listed in this policy must be included on the Front Sheet of Bridge Division plans, when applicable.

Plan View

- End of floor to end of floor dimension and stations.
- CL to CL of abutment length.
- Span numbers and lengths.
- Deck joint location.
- Concrete Rail/Barrier.
- Floor drains and station.
- Light base and station.
- CL Utilities.
- Base line information.
- Slope protection *(may be shown elsewhere).*
- Clear roadway.
- Phasing.
- Skew.
- Benchmark location.

NDOR standard specifications call for placing a benchmark *(brass marker),* near the end of the structure. For uniformity's sake, the plan front sheet will indicate the location of the benchmark on the right-hand side of Abutment #1.

Elevation View

- Station and profile grade elevation at supports.
- CL Bridge Station.
- Bearing connection designations of expansion *(E)* or fixed *(F)* at supports. The E and F labels will be omitted at integral abutments and for slab Bridges. The E ad F do not refer to the stiffness of the substructure.
- Concrete rail/barrier.
- Footing elevations *(at bottom of footing).*
- Berm elevation.
- Natural Ground Profile.
- New Grading Profile and limits left and right of CL roadway.

Note

- Profile grade line *(PGL)* location *(upper left corner of page).*
- Structure location note *(lower left corner of elevation view).*
- Utility notes.
- Deck pouring sequence note and diagram.
- Reference to Standard Plans in the lower right corner.
- Upstream and downstream limits of channel excavation.
- North Arrow.

Crossing Data

Streams

- Low steel/concrete elevation
- Flow line elevation
- Direction of flow
- Limits of riprap

Roadways

- Stationing & CL of roadway below.
- Actual minimum vertical clearance to roadway below.

Railroads

- Name of railroad.
- Horizontal clearance to obstruction.
- Actual minimum vertical clearance to railroad below.

Curve Information

- Vertical curve data and profile sketch.
- Horizontal curve layout data.

Traffic Data

Traffic data will be shown by using the cell (AC=TRDATA)

Traffic Data		
Year		
ADT		
DHV		
Heavy Trucks	%	%

AC – TRDATA

Hydraulic Information

Hydraulic information for all stream crossings shall be provided by the Bridge Hydraulic Section and shown by using one of the three available cells (AC=HYDRA1, AC=HYDRA2, AC=HYDRA3) shown below.

Format to be used without road overflow:	Format to be used with road overflow:	Format to be used with an overflow structure:
BRIDGE HYDRAULIC INFORMATION STREAM DA = SQ.MI. Q100 = CFS (DESIGN FLOOD) H.W. ELEV. = FT. (D.S. SIDE) W.W.A. BELOW H.W. = SQ. FT. Q100 GENERAL SCOUR = FT. Q100 LOCAL SCOUR = FT.	**BRIDGE HYDRAULIC INFORMATION** STREAM DA = SQ.MI. Q100 = CFS (BASE FLOOD) Q100 = CFS (BRIDGE-BASE FLOOD) H.W. ELEV. = FT. (D.S. SIDE) W.W.A. BELOW H.W. = SQ. FT. Q = CFS (OVERTOPPING FLOOD) LOW ROAD ELEV. = FT. Q100 GENERAL SCOUR = FT. Q100 LOCAL SCOUR = FT.	**BRIDGE HYDRAULIC INFORMATION** STREAM DA = SQ.MI. Q100 = CFS (BASE FLOOD) Q100 = CFS (BRIDGE-BASE FLOOD) H.W. ELEV. = Ft. (D.S. SIDE) W.W.A. BELOW H.W. = SQ.FT. Q100 GENERAL SCOUR = FT. Q100 LOCAL SCOUR = FT.
AC = HYDRA1	AC = HYDRA2	AC = HYDRA3

201.05 - Plan Revision Procedures

Advertised Projects

If a project has been advertised and has not been awarded, original plan sheets are available through PS&E. Plan changes will be made through PS&E, and a Contract Addendum will be sent out to bidders by the Contracts Section. Bidders are responsible for passing Addendums on to their subcontractors. Normally, revisions at this stage in the contract letting are limited to changes that affect the bidding.

Award Contract

The original Title Sheet and Summary of Quantities Sheet are available in the Roadway vault after a contract has been awarded *(Let).* Bridge Plan Sheets are available in the Bridge Division vault.

After changes are made, the Bridge Division will provide a letter to the Construction Division noting the revised, added, or deleted sheets. The letter should give a detailed explanation of each change resulting from the revision.

After the letter and plans have been reviewed, the construction office will provide the required prints for all parties.

Consultant Revisions

Consultants will **not** make revisions to the Title Sheet, Summary of Quantities, nor provide a letter to the Construction Engineer. This will be done by the Bridge Division.

Revision Detailing

Plan changes are to be made only on the full size original plan sheets. Full size plan revisions may be submitted on CAD reproductions in place of the full-size original sheets as long as they are an exact copy of the original Contract Plans; which will include all information added to the plans after the Bridge Division turned them in to the Roadway Designer. A log of all revisions will be documented on the plans using the following procedures:

- All revised sheets must indicate the items listed below in the top right-hand corner; an example is shown at right.

  1. Revision symbol — R/1 — April 1, 1996
  2. Date of revision
  3. When applicable: ”Added Sheet”
     or “Deleted Sheet”

- Each change will be boxed with a line through it, **Never Erase**; and be labeled with a revision symbol similar to the following example:

  Error Correction R/1

Revision Symbols

Revision symbols consist of a “R/#” contained in a circle. Revision symbol numbers will be consecutive *(R/1, R/2, etc.)* based on the date the revision is made to the Contract. When assigning a new revision number, the last recorded revision will be shown on the Title Sheet. Revisions may have more than one plan item change.

Title Sheet

The Title Sheet on all revisions must indicate the sheet(s) which have been revised by placing the revision symbol and the list of sheet number(s) beside it in the Title Sheet Index to the appropriate sheet description.

Quantities

Revised quantities will be shown on *(Roadway)* Summary of Quantities Sheet and on the *(Bridge)* Cover Sheet. The Summary of Quantities sheet will not need a revision if a revision does not alter the quantities. The Bridge Cover Sheet will not need to be revised unless other items on the Cover Sheet require a revision.

Adding Plan Sheets

In the event a new sheet is added to the plans, the added sheet number should be based on the previous sheet number in the Plans with an “A” on the end, for example: 13A or 27A.

Deleting Plan Sheets

If an entire Plan sheet is to be deleted, a large heavy “X” must be placed across the entire sheet.

Adding Special Provisions

When the plan revisions add pay items not already in the contract or in any way create the need for a special provision, the special provision shall be submitted with the revised plan sheets.

201.06 - Bridge Quantity Tolerance Policy

Tolerances

Excavation

Excavation *(Established Quantity)*	5.0	Cu.Yd.
Earthwork Measured in Embankment	10.0	Cu.Yd.

Concrete

All Concrete Quantities	0.1	Cu.Yd.
Class I Repair	1.0	Sq.Yd.
Class II Repair	1.0	Sq.Yd.
Class III Repair	1.0	Sq.Yd.
Concrete for Overlay – SF	0.1	Cu.Yd.
Placing, Finishing & Curing Concrete Overlay – SF	1.0	Sq.Yd.

Steel

Epoxy Coated Reinforcing Steel	5.0	Lbs.
Structural Steel	5.0	Lbs.
Bearing Piles	1.0	Lin.Ft.
Sheet Piles	1.0	Sq.Ft.

Slope Protection

Broken Concrete Riprap	5.0	Tons
Rock Riprap, Type “A”	5.0	Tons
Rock Riprap, Type “B”	5.0	Tons
Rock Riprap, Type “C”	5.0	Tons
Concrete Slope Protection	1.0	Sq.Yd.
Riprap Filter Fabric	1.0	Sq.Yd.

Miscellaneous

Granular Backfill	5.0	Cu.Yd.
Subsurface Drainage Matting	1.0	Sq.Yd.
All Expansion Joints *(not joint filler)*	0.1	Lin.Ft.
All Conduit in Bridge	1.0	Lin.Ft.

Twin Structures

All twin structures must have the pay quantities separated for each structure.

201.07 - English Units Policy in the Transition Period

Due to the decision to abandon the Metric units in future projects, Bridge Office Policies and Procedures *(BOPP)* shall use a dual units system, as needed, during this transition period. **All** Metric projects shall conform to the following:

Plan Numeric Format

All numbers in the Bridge Plans will not use a comma or a space to indicate the thousands place. Plans will use a space to separate the number from the metric units.

Elevation Accuracy

Grade Profile will be rounded to the nearest 1”.

Ground Profile will be rounded to the nearest 1”.

Structural Concrete will be rounded to the nearest 1/8”.

Pile cutoff will be rounded to the nearest 1”.

Loading

When the Plans refer to metric loading *(Dead or Live Loads),* newtons or force should be the units indicated *(i.e., N).*

201.08 - Channel Work

General Payment Description

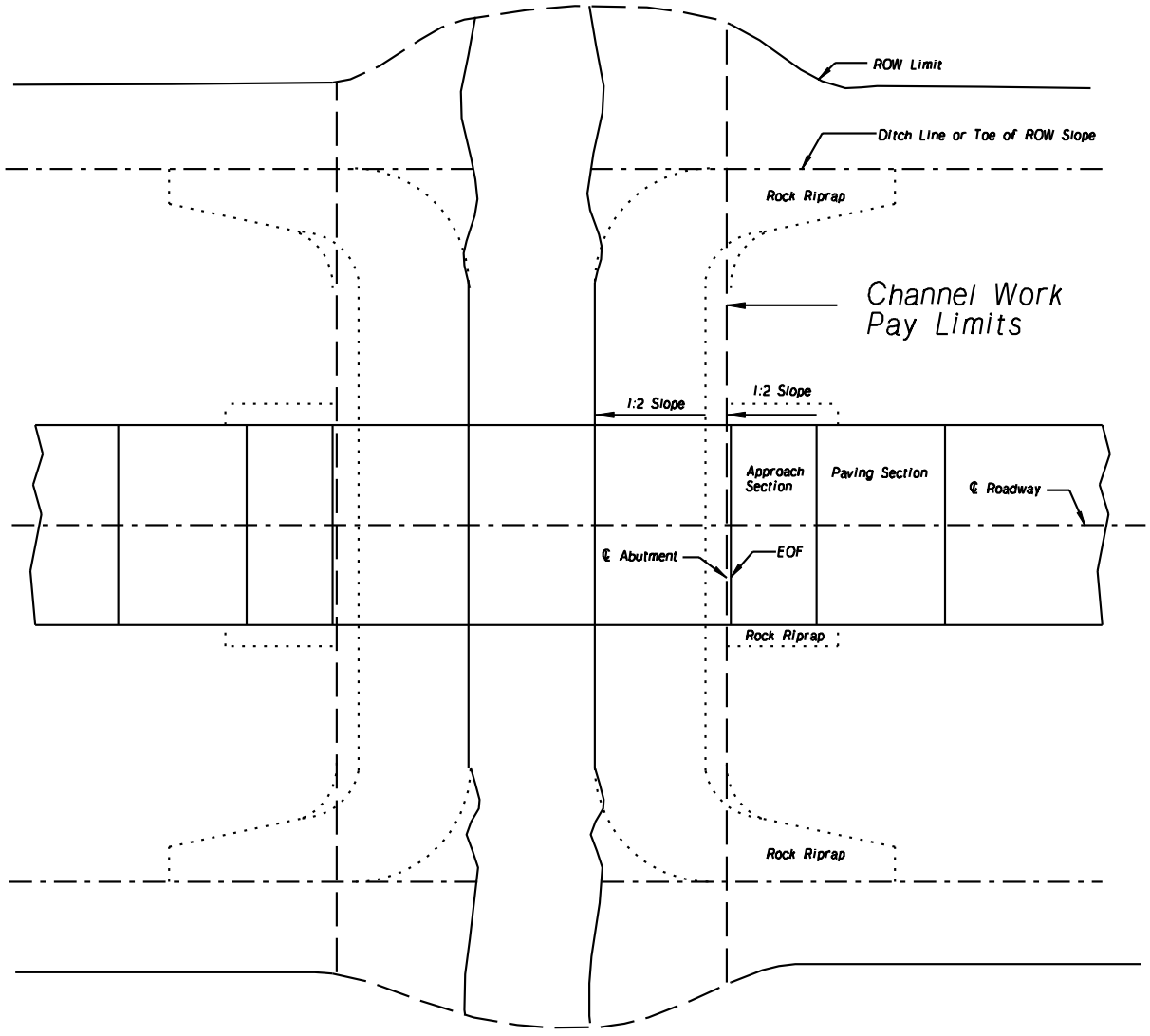
Channel work specified on the Data Sheet refers to cleaning out debris, filling in scour holes or reshaping a section of the channel at the Bridge site.

Pay Limits for Channel Work

The pay limits provided for channel work in the Bridge Plans will be from ROW to ROW *(or as specified on the Data Sheet);* and from CL abutment to CL abutment.

When Group 6 *(Bridge work)* is the only Group in a contract, the Roadway Designer is responsible for other grading work not included in the channel work.

Some projects may have extended work beyond the ROW, excessive excavation *(fill),* spur dike, etc. In these situations, the Bridge Plan pay items may pay for only a portion of the work required in the Data Sheet. Payment for extensive Channel work *(and riprap)* beyond the Bridge Plan quantity limits may be provided in the Roadway Plans as Group work other than Group 6. The Bridge and Roadway Designer will decide how the work is shown in the Plans and how the limits of payment will apply.



Quantity Calculation

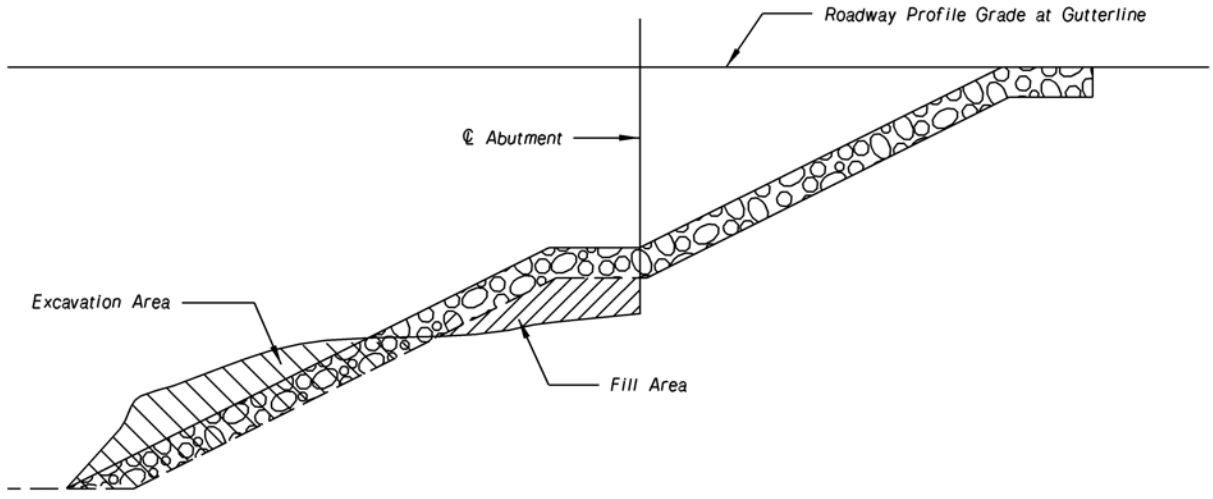
The Hydraulic Data sheet will state preliminary quantities for riprap and channel work. These quantities must be checked by the Bridge Designer.

The gross cross sectional area will be based on the new and existing ground profiles used in the hydraulic analysis. Usually, quantities will not be based on the Average End Area Method since only one cross section at the Bridge is provided.

The net cross sectional area used for quantities will be the greater area of the excavation or the fill. The net cross section will be projected upstream and downstream between the pay limits to calculate the volume of excavation.

Pay Items

Either **Excavation *(Established Quantity)*** or **Earthwork Measured in Embankment** will be used to provide payment for channel work. **Excavation *(Established Quantity)*** will be provided if the greatest net volume is excavation, and designers should provide #019 on the front sheet. The alternate pay item is **Earthwork Measured in Embankment**. This will be used if the greatest net volume is fill and designers should provide note #020 on the front sheet.



TYPICAL NET SECTION AREAS

201.09 - Shop Plans Review Policy

Definitions:

"Shop Plans"

Shop Plans are produced by the Fabricators and define how material is to be prepared, assembled finished, and/or erected.

"Fabricator"

Fabricator refers to the facility(ies) performing shop activities as cutting, welding, punching, drilling, cleaning, and painting of structural components.

"Shop Plan Review"

Review of the Fabricator's shop plans is to verify that the plans are consistent with contract documents.

Responsibilities:

"Fabricator"

The Fabricator is responsible for providing shop plans that accurately show the appropriate details, dimensions, materials, and all necessary requirements to fabricate and erect components of the structure in conformance to the contract documents.

"NDOR and Contractor"

NDOR and the Contractor are responsible for reviewing the shop plans to ensure that the fabricator has correctly interpreted the intent of the contract documents.

In-House Shop Plans Review Procedure

Contractor approves and sends the plans to Construction Division with a stamp or authorization letter.

Construction Division sends the plans to the Bridge Division.

1. The Office Manager records receiving the shop plans.
2. Assistant Bridge Engineer distributes the shop plans.
3. If the Contractor's stamp or authorization letter is missing, the plans shall be returned to Construction for resubmittal.
4. If any shop drawing has welding details, one set will be sent to the Steel Fabrication Inspection Unit for review.
5. Plans are reviewed. *(See Shop Plans Review Items)* Incorporate any Inspectors' remarks or corrections.
6. Stamp each sheet *(preferably in the lower right-hand of each sheet)* indicating the level of acceptance. The three options within the stamp are as follows:
    a. No exceptions taken
    b. Make corrections noted
    c. Amend and resubmit
7. Write a letter describing the conditions of acceptance.
    a. There are three form letters available, one for acceptance, one for acceptance if minor corrections are made, and one for rejection.

8. If plans are to be amended and resubmitted, keep one red marked copy and send two red marked copies along with a form letter to Construction. These shop drawings must be resubmitted and be treated as new shop plans.
9. Red mark each set of shop plans if minor corrections are to be made.
10. Distribute accepted shop plans as follows:
    a. File one reviewed copy of shop plans inn the project file in the vault.
    b. For all shop plans pertaining to steel fabrication, one copy must be given to the Fabrication Inspection Unit.
    c. Forward all remaining copies along with an attached letter describing the conditions of acceptance to the Construction Division for distribution.
    d. The Construction Division will distribute these copies to Materials and Research, Project Manager, Contractor, and Fabricator.
11. Record the departure on Office Manager's shop plan list.

    Note: The original of every transmittal letter should be placed in the correspondence file.

    Shop Plans are microfilmed after the project is completed in the field.

Consultant Shop Plans Review Procedure *(If Consultant is under contract for the reviewing)*

Contractor approves and sends the plans to Construction Division with a stamp or authorization letter.

Construction Division sends the plans to the Bridge Division.

1. The Office Manager records receiving the shop plans.
2. Section Head distributes the shop plans.
3. If the Contractor's stamp or authorization letter is missing, the plans shall be returned to Construction for resubmittal.
4. If any shop drawing has welding details, one set needs to be sent to the Steel Fabrication Inspection Unit for review.
5. Incorporate any Inspector's remarks or corrections before sending all of the plans to the Consultant.

Send the plans to the Consultant under contract.

6. Attach a letter indicating which fabricator the shop plans are from.
7. Record sending the plans to the consultant on Office Manager's shop plan list.

Stamped Shop Plans received from Consultant

8. The Office Manager records receiving of the shop plans.
9. Write a letter describing the conditions of acceptance.
    a. There are three form letters available, one for acceptance, one for acceptance if minor corrections are made, and one for rejection.
10. If plans are to be amended and resubmitted, keep one red marked copy and send two red marked copies with a letter to Construction. These shop drawings must be resubmitted and be treated as new shop plans.

11. Red mark each set of shop plans if minor corrections are to be made.
12. Distribute accepted shop plans as follows:
    a. File one reviewed copy of shop plans in the project file in the vault.
    b. For all shop plans pertaining to steel fabrication, one copy must be given to the Fabrication Inspection Unit.
    c. Forward all remaining copies, along with an attached letter, describing the conditions of acceptance to the Construction Division for distribution.
    d. The Construction Division will distribute these copies to Materials and Research, Project Manager, Contractor, and Fabricator.
13. Record the departure on Office Manager's shop plan list.

Note: The original of every transmittal letter should be placed in the correspondence file.

Shop Plans are microfilmed after the project is completed in the field.

County Shop Plan Review Procedure for Projects

Let On and After October 10, 2002

1. Prior to the letting, the Agreements Section in Project Development will prepare an agreement with the county's consultant to review shop drawings, calculate girder shims, and provide construction consultation. Exceptions to this may be when the design consultant is no longer available.
2. Contractor approves and sends the shop drawings to the Construction Division with a stamp or authorization letter.
3. The Construction Division will send any shop drawings with welding details to the Steel Fabrication Inspection Unit in the Bridge Division for review.
4. The Steel Fabrication Inspection Unit will review the welding details and return the shop drawings to the Construction Division.
5. The Construction Division will send the shop drawings to the consultant.
6. The consultant will review the shop drawings and return them to the Construction Division.
7. The Construction Division will distribute the reviewed shop drawings as follows:
    - One copy will be sent to the Bridge Division for the project file.
    - One copy will be sent to the Steel Fabrication Inspection Unit in the Bridge Division.
    - Remainder of copies will be distributed to Materials and Research, the Project Manager, Contractor, and Fabricator.

Shop Plan Review Items

The following items shall be considered essential for reviewing all shop plans:

1. **General Items**
    - Project Number, Control Number, and Structure Numbers are required on each sheet. *(Preferably on the lower right-hand corner)*
    - Material specifications.
    - Primary dimensions.

- Girder length, span length *(distance between bearings or other points of support)* and girder layout, where applicable.
- Weight per foot for rolled shapes and concrete girders.
- All dimensions of bearing devices.

2. **Steel Girders**
   - Thickness and width of plates in primary members and splices.
   - Diameter, specifications, grade of mechanical fasteners, and coating, if required.
   - Camber and blocking ordinances.
   - Specification, grade and toughness testing requirements for all components.
   - Size of fillet welds, appropriate partial joint penetration, and complete joint penetration weld configurations.
   - Shop butt weld splice locations.
   - Location of tension and compression zones in welded members.
3. **Bolted Splices**
   - Size of all plates.
   - Number, size, and spacing of bolts.
   - Bolt hole edge distance.
   - Fill plates, if required.
   - Direction of rolling.
4. **Cross Frames and Diaphragms**
   - Location and spacing
   - Bolt edge distance, spacing, and compatibility with diaphragm/cross frame connections
   - Direction of rolling.
5. **Prestressed Girders**
   - Jacking force.
   - Strand size and location.
   - Shearing reinforcing size and location.
6. **Post-Tension Girders**
   - Details, description, and specifications of anchoring devices.
   - Jacking
   - Stressing sequence.
   - Anchor block dimensions and reinforcement
   - Center of gravity of ducts and post-tensioning tendons matches contract plans.
   - Seating, friction, and time dependent losses.
   - Elongation of strands in all tendons. This will be compared with the field measurements.
   - Type of ducts.
   - Grout tube, grout vent details, and locations.
   - Strand positions in conduit in sag and summit tendon curves.
   - Geometric details *(blockout and coupler details).*

SECTION 202: GENERAL DESIGN ITEMS

202.01 - Definition of Bridge Terms

Term	Definition *(as used in this manual)*
Superstructure	All portions of the Bridge above and including the girder bearing device or above the bottom of the slab in the case of slab Bridges.
Substructure	All portions of the Bridge below the girder bearing device or below the slab in the case of slab Bridges.
NDOR Standard	Nebraska Department of Roads Standard Specifications for Highway Construction.
EOF	An acronym for End of Floor, which is the end of the Bridge deck at-grade.
Live Loads	H and HS loadings as defined in AASHTO 16th Edition & HL93 as defined in AASHTO LRFD.
Bent	Bridge supports between abutments that have spread footings with or without piles.
Berm Elevation	The elevation at the abutment berm for the top of the concrete slope protection; or the bottom of the riprap. This elevation must be shown on all Plan Front Sheets.
Slope	Slope is defined as the ratio of run to rise. In written form, the first number indicates run and the second number indicates rise, i.e., 2:1 *(run:rise)*.
Contractor	When the term “Contractor” is used, it shall mean the person that is awarded the project and must be the only method used in the Plans to identify who is doing the work. Plans shall not refer to other subcontractors, such as: Grading, Bridge, or MSE Contractor. This implies that work may be the responsibility of someone other than the prime contractor.
PS&E	Project Scheduling and Estimate Section of the Construction Division.

202.02 - Bridge Loading Policy

Impact Loads

The following tables are intended to provide consistent application of impact loading on various components of Bridge structures and to clarify AASHTO Specifications.

Apply Impact Loads	Do NOT Apply Impact Loads
All portions of the superstructures	Bearings regardless of type.
The portion of the pier above the ground line, except the footing	Abutments and retaining walls.
The portion above the ground line of concrete and steel piles that are rigidly connected to the superstructure.	The portion of the pier below ground line and the pier footing.
	Design bearing of the pile.
	Sidewalk loads.
	Timber structures.

Example

Open pile bent on concrete slab Bridge with piling embedded in bent cap and the bent cap is rigidly connected to slab or superstructure. Therefore, that portion of the piling above the ground line shall include impact in its design. However, the design bearing required for the pile shall not include impact.

Permanent Loads

Dead Loads

Bridge deck, haunch, stay-in-place forms and diaphragms are considered a non-composite dead loads acting on the girders before concrete deck has cured.

Superimposed Dead Loads *(Loads on composite section)*

Railings, wearing surface, utilities and signage are considered superimposed dead loads distributed equally to all girders or distributed uniformly across concrete slabs.

- Concrete Barrier or Rail: In general, concrete barrier or rail loads are distributed equally to all girders for normal cantilever conditions.
- Future Surfacing: Future surfacing is assumed to be 20 psf and shall be applied to all new superstructure and substructure designs. Future surfacing loads shall not be included in the deflection calculations for shims.
- Interior Median Curbs: Interior median curbs will be designed and specified in the Plans as a composite load. In other words, a construction joint is mandatory. *(See details in Section 301.04)*

Live Loads

All new Bridge projects will meet the requirements of AASHTO HS25 or AASHTO LRFD HL93 for live load. Live load distribution factors will be as specified by AASHTO.

Live Loads *(continued)*

Existing Superstructures

When the entire superstructure is being replaced, the new superstructure will be designed for HS25 using AASHTO Standard Specifications or HL93 using AASHTO LRFD.

The following procedures will apply to rehabilitation and widening projects.

1. If capacity of the existing superstructure is AASHTO HS25 or greater, design the widening portion for HS25.
2. If the capacity of the existing superstructure is between AASHTO HS20 and HS25, design the widened superstructure for HS20.
3. Investigate to determine the feasibility of strengthening existing superstructures that do not have at least an AASHTO HS20 live load capacity.
4. If the economical and structural analysis indicate that strengthening is feasible, then design the widened superstructure for AASHTO HS20.
5. Existing superstructures which do not have at least an AASHTO HS20 live load capacity and cannot be structurally and/or economically strengthened, should be brought to the attention of the Assistant Bridge Engineers for evaluation on a case-by-case basis.

If it has been determined to widen a Bridge that has less than AASHTO HS20 live load capacity, a justification sheet will be attached to the Bridge data sheet. As a minimum, the justification sheet will include the following:

HS20 inventory rating capacity
HS20 operating rating capacity
Posting capacity for Type 3 truck
Posting capacity for Type 3S2 truck
Posting capacity for Type 3-3 truck
ADT
ADTT
Year built
Discussions of pertinent details;
Pin & hangers, cover plates, stiffeners, welds, _____.

Existing Substructures

Designers will evaluate each Bridge substructure and consult with the Geotechnical Engineer to insure that it is capable of supporting the design load required in the superstructure. If the initial investigation of the substructures indicates low capacity, notify the Assistant Bridge Engineer.

202.03 - Structural Steel Policy

During the transition period from Metric to English units, the following policy shall apply for all Metric projects.

Rolled Sections

All rolled shapes shall be specified using metric designations according to ASTM A6/A6M. In general, most of these materials are fabricated using English units. Other rolled sections, such as round and flat bars, will be specified in metric Plans using English dimensions rounded to the nearest 1 mm.

Suggested Metric Equivalents					
English (in.)	**Metric (mm)**	**English (in.)**	**Metric (mm)**	**English (in.)**	**Metric (mm)**
1/4	7	1-1/8	28	2-1/8	54
3/8	9	1-1/4	31	2-1/4	57
7/16	11	1-3/8	35	2-3/8	60
1/2	12	1-1/2	38	2-1/2	63
9/16	14	1-5/8	41	2-5/8	66
5/8	16	1-3/4	44	2-3/4	69
3/4	19	1-7/8	47	2-7/8	73
7/8	22	2	50	3	76
1	25				

Steel Plate

The local steel industry, in concurrence with AISC, has recommended developing production of hard metric thicknesses for metric plate steel applications. This would include all bent plate separators and plate girder webs and flanges. Plans will specify the metric thicknesses *(mm)* for plate steel as shown in table.

Metric Plate Thicknesses			
5	9	20	32
5.5	10	22	35
6	12	25	38
7	14	28	40
8	18	30	>40 use 5mm
5/8			increments

Steel Pipe

Similar to rolled sections, steel pipe will be fabricated using English units and will remain English. The following metric designations will be used.

Metric Designations			
English (in.)	**Metric (mm)**	**English (in.)**	**Metric (mm)**
1/2	15	2	50
3/4	20	2-1/2	65
1	25	3	80
1-1/4	32	3-1/2	90
1-1/2	40	4	100

202.04 – Structural Steel Connections Policy

Bolted Connections

All bolted connections for structural steel shall be fabricated with 7/8-inch high-tensile bolts that meet the requirements of ASTM A325.

Welded Connections

In general, fabricators will use the minimum weld size in the AWS D1.5 welding code when weld sizes are not specified on the Plans.

It is the designers' responsibility to specify the required weld size in the plans for welds larger than the minimum.

202.05 – Approach Slab Policy

General Design

Approach slabs will be required on all State projects. Plans and elevation views of approach sections should be shown on the front sheet of Bridge plans.

For Bridges that are to be widened, the existing Bridge and location should be investigated to determine any deviations from the standard approach layout.

Design Criteria

Approach Section

The approach section length shall be 20 ft. from the end of the Bridge floor to CL grade beam; see Grade Beam Policy for more information. The approach section reinforcing details shall be as shown in Chapter 6, approach slab base sheets. The depth of the approach section shall be 1'-2" and placed above the abutment wing; see Wing Policy for more information.

Paving Section

The paving section length shall be 30 ft. from CL grade beam to the road pavement along CL clear roadway. The joint between the paving section and the roadway shall be perpendicular to CL roadway. For wide Bridges and/or large skew angles, designers shall consult with the Assisant Bridge Engineer on a case-by-case basis.

The thickness of the paving section shall be 1'-0". A 1'-2" thick paving section shall be used to match the Omaha area interstate pavements. The reinforcing details shall be as shown in Chapter 6, approach slab base sheets.

If abutment wings extend beyond the grade beam, changing paving section layouts is not recommended.

Designers shall show elevations of the end of pavement sections at left edge, center and right edge.

Reinforcement Layout

Longitudinal bar spacing is always measured perpendicular to CL roadway and placement is parallel to the CL roadway. Designers should check longitudinal bar lengths to verify if the skew dictates a shorter bar. Field personnel indicated that omission of these slight skew adjustments have caused problems for joint installation. Transverse bar spacing is always measured parallel to CL roadway. Placement may be perpendicular to CL roadway or skewed.

Roadway Joint

When the roadway is concrete pavement, use 3" joint filler *(Fiber Type)* topped with 1/2" joint sealant and 1 1/2" x 18" smooth tie bars at 12" centers. When the roadway is asphalt, no joint is required.

Expansion Joint

Joint systems will be placed between the approach section and paving section in the approach slab. For information on approved expansion joint systems, see Chapter 3, **Expansion Devices**.

One layer of SBS modified Asphaltic base sheet placed on a steel troweled smooth surface will provide a bond breaker for Bridge expansion between the approach section and the grade beam.

Longitudinal Joints

Longitudinal joints shall be placed in the paving sections. Wide paving sections should have additional joints placed at the edge of the traffic lanes. Bridge designers should check with the roadway designer for the exact location of the traffic lanes. The perpendicular distance between joints will not exceed 24 ft.

Payment

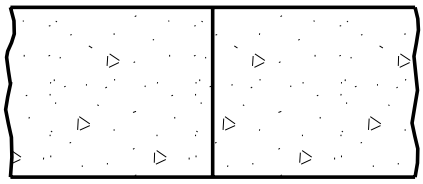
The pay items **Concrete for Pavement Approaches Class 47BD-4000** and **Epoxy Coated Reinforcing Steel for Pavement Approaches** includes all concrete and steel for placement of the paving and approach sections, and all rail attached to the approaches.

Bridge Base Sheets

There is one reference file available for the approaches; *(see Chapter 6).* Zero, RHB, and LHB skews are shown on Sheets A, B, and C, respectively.

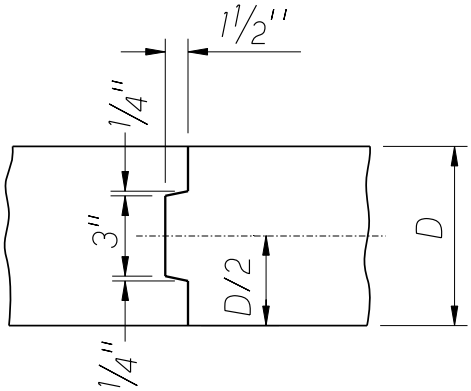
202.06 – Construction Joint Policy

Slab construction joints less than 8 1/2” shall be indicated as a vertical line in the Plans, as shown below.



Slab Construction Joint

Slab construction joints greater than 8 1/2” will provide a tapered blockout. The cell AC=JOINT2, shown below, may be used in th Plans.



AC = JOINT2

202.07 – Temperature Movement Policy

General

Movements resulting from expansion and contraction due to temperature change will occur throughout the life of the structure. Temperature movement *(TM)* for any given location shall be based on the variations in temperature in this location. The Bridge Office Policy defines the Temperature Movement *(TM)* as the total anticipated movements due to the rise and fall of temperature. Other design policies may provide factors to modify *(TM)* calculations.

Temperature Movement Calculation

$$TM = [\Delta T]\ [\alpha]\ [L]$$

Where

ΔT = Design Temperature range

- = 130°F for steel only.
- = 110°F for concrete deck on steel girder Bridges.
- = 90°F for concrete applications.

α = Coefficient of thermal expansion

- = 6.5×10^{-6}/°F for steel.
- = 6.0×10^{-6}/°F for concrete.

L = Length from point of no movement to the point at which the length of expansion is desired.

202.08 – Utility Policy

General Utility Criteria

- Utilities may be attached to a new structure if the attachment is determined to be in the best interest of public agencies.
- Utility attachments will generally not be permitted on Interstate or Freeway Bridges that have not been specifically designed to accommodate them, except to exclusively serve a highway facility.
- Utility attachments to existing structures crossing Interstate or Freeway highways are considered on an individual basis.
- The utility company shall be responsible for designing the support systems to be included in the Bridge plans.
- All utilities shall be carried in protective conduit or pipe.
- Utility lines shall be suspended by means of cast-in-place anchors, whenever possible.
- Anchors driven using explosive type driving force methods shall not be allowed.
- Attachment of conduits to Bridge handrail and guardrail components shall not be allowed.
- Clamping devices for attachment to structural members shall not be allowed.
- Welding or drilling holes in primary structural steel members shall not be allowed.
- Drilling or cutting holes in prestress and reinforced concrete girders shall not be allowed.
- Manholes used to service a utility shall not be located in the Bridge deck, approach slabs or in the median. Such manholes shall be located beyond the edge of the roadway *(pavement and shoulders).*

Bridge Design

Bridge designer shall be responsible for determining if any utilities are to be attached to the structure. This information will be obtained from the Utility Section of the Project Development Division.

When utilities are required on a structure, Bridge designer shall determine the placement of the utility lines on the structure. Bridge plans shall include the hardware specifications and details for the utility attachment as provided in the written correspondence.

The following information should be provided by the Utility Company and included on the Bridge data sheet: where the utility is relative to the limits of the Bridge structure; number, type, size, and weight of utility lines; insert size and spacing; minimum bending radius for the conduit or pipeline specified; contact person for utility.

Superstructure Attachment

Utilities shall be placed beneath the structure's floor and inside the outer line of girders; and shall not extend below an elevation that is 1 ft. above the bottom flange. Utility lines will not be attached to nor supported by bent plate steel separators. Shop fabricated holes will be allowed to pass utility lines through bent plate separators. In which case, the separator holes shall be designed and sized to preserve the strength and stiffness of the member. Cast-in-place PVC sleeves or blockouts must be provided to pass utility lines through concrete diaphagms.

Concrete slab or inverted tee structures should have utilities placed in the concrete rail or barrier. Conduits cast inside the concrete slab or located inside the voids between inverted tee sections should be avoided but may be necessary.

Substructure Attachment

All utility lines extending through abutment walls shall use cast-in-place PVC sleeves. Utility installation through piers or wingwalls shall not be permitted. Utilities shall continue under the Bridge approach section and below the grade beam. Utilities shall exit from under the paving section at an angle of 45° to CL roadway, 3 ft. min. beyond the end of the wing, and at a depth of 3 ft. ±6" below grade. Bridge designers shall use caution when placing the utility lines to avoid guardrail posts *(wood and steel alternate post spacing).*

Detailing

The location of utility CL shall be shown on the front sheet. Elevation views of utilities in steel separators or in concrete shall be shown on the cross section of the roadway sheets; and as necessary in other detals to ensure the proper placement of the utility.

Payment

All additional cost attributed to the installation of the line shall be paid for by the utility company unless such attachments are made a part of or in lieu of utility relocation costs as determined by the Utility Section.

The additional cost of extra items such as structural steel and fabrication needed to support the pipeline and/or conduit beyond what is needed for highway purposes will be determined by the state at the following rates.

Bent plate separator modification**	$150.00	each
Insert installation	2.00	each
Sleeves installation	50.00	each
Conduit installation	6.00	/ft
Engineering time *(8 hrs. min.)*	25.00	/hour
Drafting time *(10 hrs. min.)*	15.00	/hour

** This unit cost is based on 6 or more separators. If less than 6 separators are involved, the unit cost should be increased proportionately from $150.00 to $250.00 per separator.

Notes:

- Standard Note #013 shall be modified and placed on the front sheet of the Bridge plans.
- The actual name of the Utility Company, the name of the contact person and their telephone number must replace the generic text in Standard Note #013.
- Standard Note #014 shall be placed on the utility sheet of the Bridge plans.

202.09 – Lighting Policy

General Criteria

Lighting will be indicated in the Bridge Data Sheet. Bridge designers should provide the Lighting Section of Roadway Design with the stations at the exterior of the Bridge deck on the CL of supports. The Lighting Section will then provide the lighting requirements and locations in a memo. This memo will be filed in the Bridge Division correspondence file.

Light pole bases and underdeck lighting should be shown in the Plan View on the Front Sheet.

Light Base Design

A standardized light base layout and reinforcement is shown in the Lighting Base sheet, see Chapter 6. In general, 0.4 in./ft. of lighting reinforcement is added to the Bridge deck reinforcement to support the light pole base. The standard design assumes the following criteria:

- 6'-6" is the maximum effective cantilever distance, *(from the effective support to the outside edge of the Bridge deck).*
- Light pole base: 2' square x 9" thick
- Light pole weight = 375 Lbs.*:* 42' pole, 9" base, 1.17% taper
- Mast arm is 72" with a 36" riser.
- Luminaire weight = 50 Lbs*.*

PVC Conduit Layout

Conduits should be located in the concrete rail or concrete barrier as shown in the base sheets. Conduits will extend approximately 10' beyond the exit from the concrete and terminating 10' to 13' from the outside edge of the roadway, 3' below grade with capped ends.

A plan view of the conduit layout *(horizontal plan dimensions)* must be provided in the Plans. Layouts will show the following items:

- Limits of Pay Quantity for 1 1/2" Conduit in Bridge.
- Junction boxes, expansion fittings and capped ends of the conduit.

Junction Boxes

Nema 4, Type YR cast iron electrical boxes 10"x6"x6" will be located near each light base or under deck light. Additional boxes should be provided when the direction of the conduit changes more than 180 degrees. Conduit stubouts 3/4" will be shown from the junction boxes to the light base or underdeck lights. Stub out ends should be threaded, capped and have a 2" projection.

Expansion Fittings

Expansion fittings 4" minimum must be used at all locations where the conduit passes through expansion gaps, as shown in the cell (AC=EXPAN).

For expansion movements greater than 4"*,* larger fittings should be specified in increments of 2".

Lighting Base Sheet

The lighting base sheet contains the details for a standard light base. There are detailing options on MicroStation levels that show a concrete rail, 2'-8" barrier, and 3'-6" barrier; see Chapter 6.

Payment

The concrete for the light base will be paid for with the Bridge deck concrete as **47BD-4000 Concrete for Bridges**. The reinforcing steel should be labeled as "L" bars on the Bill of Bar Sheet and paid for with the deck reinforcement as **Epoxy Coated Reinforcing Steel**.

All conduit, junction boxes, expansion fittings, drains, Liquid-tight Flexible Conduit, couplings, anchor bolt assemblies, all other miscellaneous hardware and labor required for the installation of the conduit system will be subsidiary to the item, 1 1/2" **Conduit in Bridge** as stated in the standard special provision.

202.10 - Phased Construction Policy

If detouring the roadway or using a shoofly around the Bridge are not practical or cost effective solutions, Bridge construction shall be phased.

Temporary Traffic Lane Widths

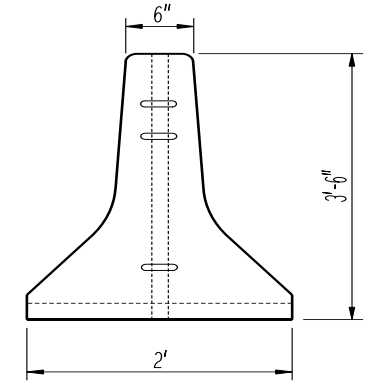
It may be necessary to build the new Bridge 1'-0" or 2'-0" wider to accommodate the temporary traffic lanes. Phased traffic should be provided with the maximum lane width available. Roadway Design, Traffic, and Bridge Divisions should jointly approve lane widths to meet the following minimums:

Interstate

- 14'-0" minimum for a single lane and 25'-0" for two lanes.
- 13'-6" minimum each lane for opposed traffic *(head to head).*

State Highways

- 12'-0" recommended and 11'-0" minimum.



TEMPORARY BARRIER

AC=WPBAR

Temporary Barriers

Temporary Barriers have the New Jersey barrier shape as shown in the cell, *(AC = WPBAR).* The recommended distance between the barrier C.L. and the edge of the deck *(or slab)* must be 2'-6" minimum for state highways and 3'-3" for Interstate. The assumed weight of barrier per foot should be 0.38 klf*.*

Reinforcement

Designers must allow enough distance between existing concrete and the joint to place the lap. Reinforcement lapped at phased construction joints should be shown in the plans as two bars, with different marks, and the minimum splice length dimensioned.

If mechanical splices are used, Standard Note #323 must be shown in the plans, preferably in the Cover Sheet General Notes.

When a pier or bent requires temporary support for phased construction, the Cover Sheet should indicate the pay item **Temporary Supports** *(each).* A special provision for "Temporary Supports" must be included in the contract that describes payment and specifications.

Paving Sections

For phased construction, the longitudinal joint in the paving section shall be eliminated. For wide paving sections requiring additional joints, the Longitudinal Joints Policy shall apply *(see 202.05).*

Phased Construction Shoring

The Contractor must provide shoring as necessary to support the roadway embankment during construction phases. Bridge Plans will provide shoring for phased construction by using one of the two methods outlined below.

Method 1:

This should be used when minimal shoring is expected.

- Shoring is not shown on the Plans.
- Payment is subsidiary to the pay items for **Abutment Excavation** and specified in the Preparation of Structure special provision.

Phased Construction Shoring *(continued)*

Method 2:

This should be used when the Plans require the shoring to be designed by a Professional Engineer. Items contributing to significant shoring would be cost, height or length of fill, and importance of project.

The designer will determine whether or not shoring should be considered permanent Bridge Shoring or Temporary Bridge Shoring.

- Shoring that the contractor may remove when the construction is completed will be labeled on the Plans as **Temporary Bridge Shoring**.
- Shoring that the contractor may not remove, *(flame cut 4" below concrete for example)* will be labeled on the Plans as **Bridge Shoring**.
- The approximate CL of shoring must be called out on the Plans, typically on the Geological or Front Sheet, in the locations where it is needed. Size of shoring and dimensions should not be used on the Plans. Approximate stationing must be used to indicate locations of shoring to the nearest foot of accuracy ± *(approximate Station 123+25 ±, for example).*
- Bridge Shoring special provision 5B-7E shall be included in the project contract.
- The pay items **Bridge Shoring** *(Lump Sum)* or **Temporary Bridge Shoring** *(Lump Sum)* will be shown on the Cover Sheet as required. The Assistant Bridge Engineer will provide an estimate of the quantity Sq.Yd. for PS&E. The estimate will be calculated based on the exposed surface area of the shored soil.

Note:

The Bridge Division has decided to pay for the Bridge Shoring as a lump sum quantity because too many contractors have bid and placed the shoring to the exact station or dimension given in the Plans and failed to properly protect the roadway fill. Therefore, the Plans will indicate approximate information for the purpose of bidding only.

MSE Wall Shoring

See Section 202.11.

202.11 - Mechanically Stabilized Earth (MSE) Wall Policy

General Criteria

The following information must be provided on the Geology Sheet when the Bridge Data Sheet requires MSE wall.

- CL abutment to the front face of wall will be a minimum of 5 ft..
- Corrugated Metal Pipe *(CMP)* size 18" or 24", cutoff elevation, and CMP length at each pile location. The size and quantity LF of CMP will be calculated by the Bridge Designer and provided to the Roadway Designer.
- Standard Note #640.
- The top of the MSE wall will be 2 ft. below the bottom of the girder.
- The bottom of the abutment concrete will be at least 8" below the top of the MSE wall.
- Phased construction will indicate a CL of MSE shoring, *(do not locate).*

Wing Layout

MSE walls should not normally be used as an abutment wing. However, when this is required by Roadway Design, the following items must be indicated in the Bridge Plans.

- Wall layout required for abutment design.
- Wall Elevations.
- Details showing the top of wall and the bottom of the approach slabs.

Concrete Rail and Barriers

All concrete rails should be designed to prevent runoff water from spilling or penetrating behind the MSE walls. Therefore, concrete rail on the approach sections must be closed and extend along the paving sections. In addition, the gap over the grade beam and the gap at the end-of-floor must be sealed.

Grade Beam Piling

When the grade beam piling is closer than *(0.9 times the MSE wall height)* from the CL MSE wall, designers must lay out grade beam piles directly behind abutment piles. This means if you drew a line perpendicular from the CL abutment passing through the abutment piles, the grade beam piles would also fall on this line.

Roadway Guidelines

The following pages contain a reproduction of the list of steps used by the Roadway Designer for retaining wall design. This has been provided in the BOPP Manual for the Bridge Designer to understand the Bridge Division's role in the design process. The statements below are to clarify steps in the guidelines.

Conventional Walls
Step 6 indicates, "If a conventional wall was selected, the Bridge Division shall design the wall and submit the special plan and associated Special Provisions to the Roadway Designer." These conventional walls will be provided by the Special Projects Section of the Bridge Division.

Shop Plan Review
Step 12 indicates, "The Bridge Division shall review the geometric aspects of the wall as they pertain to the Bridge." The Bridge Designer will review the elevations, stations, and dimensions shown on the Geology Sheet.

202.12 - NDOR Retaining Wall Design Guidelines

From Conception through Shop Plan Review

Revised February 2, 2001

Step 1: Identify the need for a retaining wall during Activity 202 – Engineering Review.

Step 2: Project Development requests Preliminary Foundation Report – Activity 603 from Material and Research Geotechnical Section.

Step 3: Confirm the need during Activity 307 – Preliminary Roadway Design and order Final Foundation Report – Activity 604.

Step 4: The Final Foundation Report shall be submitted to the Roadway Designer and Bridge Division.

Step 5: The Roadway Designer shall schedule a meeting with M&R Geotechnical Section and Bridge Division in order to select the appropriate wall type *(i.e., MSE Panel; MSE Block; or conventional Cast-in-Place wall)*. Prior to the meeting, the Roadway Designer should have compiled all relative information, such as, wall length, height, surcharge loading and other factors relative to the wall construction.

Step 6: If an MSE Panel or Block wall was selected, the Roadway Designer shall design the wall's general characteristics to be incorporated into the bid plans, along with the appropriate generic Special Provision, for English projects. For metric projects, the specifications are in the new Metric Standard Specifications Book. The approved wall vendors are listed in the Approved Products List. As a minimum, the wall plan should include:

a. All wall geometrics – length, height, stationing, offsets, leveling pad elevations, etc.

b. Traffic data

c. Construction sequencing, if applicable

d. Surcharge loading *(due to traffic or embankment)*

e. Architectural notes

f. The calculated "Established Quantities"

1. Concrete Face Panels *(SF)*, or

   Wall Materials *(SF) (for Modular Block Walls)*

2. Concrete Leveling Pad *(LF)*, or
   Compacted Earth Leveling Pad *(LF) (for Modular Block Walls)*

3. Coping *(LF) (if applicable)*

4. Select Granular Backfill for Mechanically Stabilized Earth Structure *(CY)*

5. 18" Corrugated Metal Pipe *(LF) (if applicable)*

6. If the MSE wall is used at bridge abutments and the wall is built in two phases, then add the item; Shoring for Mechanically Stabilized Earth Structure *(Lump Sum)*

g. All the "External Site Factors" per the "Design Requirements" section of the generic Special Provision. These factors should be found in M&R geotechnical Section Final Foundation Report.

h. Ensure that the following note is placed on the plan near the "External Site Factors"; The contractor, in conjunction with the MSE Wall vendor, shall determine the wet unit weight of the select granular backfill material used in the reinforced soil zone. The unit weight shall be shown on the wall shop plans.

i. Utilities

j. On metric plans, list MSE Wall vendors per the "Approved Products List" *(Terry Masters, Ext. 4754).*

If the MSE wall is to be used at a Bridge location, submit MSE wall special plan to Bridge Division for review.

If a conventional wall was selected, the Bridge Division shall design the wall and submit the special plan and associated Special Provisions to the Roadway Designer.

Step 7: Advertise Project

Step 8: Bidding contractors shall send MSE Wall plans and Special Provisions to the approved wall vendors *(listed in the Special Provisions or the Approved Products List)* in order to secure bids.

Step 9: The awarded contractor submits six sets of shop plans and working drawings *(stamped by a Nebraska P.E.)* to the Construction Division *(currently Mark Traynowicz, Ext. 4452)*. The Construction Division shall place a **Reviewed** stamp on the first sheet of all six sets *(similar to the one shown below).*

Reviewed by: Roadway Design
M&R Geotechnical Section
Bridge
Construction

Construction Division will then forward all six sets to M&R Geotechnical Section.

Step 10: The M&R Geotechnical Section to review the "External Stability" of the wall. After M&R Geotechnical Section sign and date the review stamp on all six sets, they will forward all six sets to Bridge Division.

Step 11: The Bridge Division shall review the geometric aspects of the wall as they pertain to the Bridge. Again marking corrections, deletions and concerns in red, on all six sets. After Bridge signs and dates the review stamp on all six sets, they will forward all sets to Roadway Design.

Step 12: The Roadway Designer shall review the submitted plans for the wall geometrics and to ensure that the plans reflect the bid plans. Corrections, deletions, or concerns should be marked in red on all six sets. Sign and date the Reviewed stamp. They shall keep one set, forward one set to M&R Geotechnical Section and four sets to Construction.

Step 13: The Construction Division will then distribute one set to the District Office, and the remaining three sets to the Contractor.

SECTION 203: STANDARD NOTES

203.01 - General Notes

001 This structure is designed in accordance with the AASHTO “Standard Specifications for Highway Bridges”, 17th edition.

002 The superstructure of this bridge is designed by load factor design method. The girders and substructure are designed for a future wearing surface of 20 psf.

003 The superstructure of this bridge is designed by Load Factor Design method and for a future wearing surface of 20 psf.

004 The existing structure was built under project _____, dated __/__/__. Plans are available from the Bridge Division upon request.

005 All dimensions shown are in horizontal plane only. No allowances have been made for vertical curve or roadway cross slope.

006 The Contractor may substitute any one of the alternate designs shown on the plans for the original design. All quantities are based on the original design and no additions or deductions will be allowed for the use of an alternate design.

007 This structure is designed in accordance with the AASHTO LRFD Bridge Design Specifications, Third Edition.

008 The concrete bridge deck is designed by the empirical design method in accordance with AASHTO LRFD, Second Edition. The girders are designed by Load Factor Design method and for a future wearing surface of 20 psf.

009 The prestressed girders have been designed assuming 100% continuity at the interior supports for live load.

010 The girders for this bridge are not designed to resist any torsional or laterial forces due to temporary construction loads. The Contractor must provide any temporary bracing necessary to support the girder web and flanges against all torsional or lateral forces resulting from construction loads.

011 **(The Utility Company)** shall furnish all PVC sleeves, conduit, inserts, and hardware required for the utility attachment to the bridge. All material to be installed by the bridge contractor shall be delivered to the bridge site by the utility company within 72 hours after notification from the bridge contractor. The contact person for **The Utility Company** Is Mr. XXXXX and can be reached at (XXX) XXX-XXXX.

012 The contractor shall install the sleeves and inserts as shown on the plans. The contractor shall install the conduit from the face of the abutment to the toe of the slopes under the approach slabs but will not be required to install the hangers and conduit between abutments. The installation by the bridge contractor will not be paid for directly but shall be subsidiary to the item “Class 47BD-4000 (47BD-30) Concrete for Bridges”.

013 For details of Concrete Piling, see Standard Plans 617-R3.

014 Structural steel for all “H” piles shall conform to ASTM A709M/Grade 36.

015 Girder shims that will be provided to the contractor account for the dead load deflection due to weight of the slab and rail or barrier only. The contractor is responsible for making the necessary adjustments for the particular forming system used to achieve the slab grades and elevations shown on the plans.

016 The Pay Item “Excavation *(Established Quantity)*” shall include the channel excavation/fill through the bridge as shown on the plans.

017 The Pay Item “Earthwork Measured in Embankment” shall include jthe channel excavation/fill through the Bridge as shown on the plans.

018 The post-tensioned girders have been designed assuming 100% continuity at the interior supports for deck dead load, superimposed dead loads and live load.

203.02 – Rolled Beam Girder Bridge

Grade 36

101 All structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

102 All other structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

Grade 50

111 All structural steel for rolled beams and all splice material shall conform to the requirements of ASTM A709/A709M, Grade 50.

Weathering Steel

121 All structural steel for rolled beams, stiffeners, separators and all splice material shall conform to the requirements of ASTM A709/A709M, Grade 50W weathering steel.

122 Nuts, bolts, and washers used in the assembly of weathering steel shall be Type 3.

Fabrication

131 All bearing stiffeners and girder ends, except at field splices, shall be vertical after final erection. All other stiffeners and all field splices shall be normal to the top flange.

132 During girder fabrication, the flanges at the splice must line up within 1/8” of parallel to the adjacent flanges without applying external force, before the splice is drilled.

134 All rolled beams and splice plates shall be considered main tension members for the purpose of Charpy-V-Notch tests.

135 All rolled beams shall be placed with mill camber upwards.

137 The contractor may eliminate any of the bolted field splices by extending the heavier of the beams so connected. The contractor shall make all necessary adjustments in bearings and bearing seat elevations caused by these changes. These changes and a revised blocking diagram shall be shown on the shop plans and will be subject to approval by the Engineer. No change in contract price or quantities will be made for this change.

Field Assembly

151 All fasteners shall be 7/8 in. high strength bolts, ASTM A325.

152 Field tack welding of form hangers or miscellaneous hardware to any part of the steel girder, with the exception of the shear connectors, shall be prohibited.

153 When assembling the girders in the field, they shall be set according to the blocking diagram before any bolts are tightened to a snug-tight condition.

154 Field splices shall be clean and free of all foreign matter before field assembly. The plates shall be in full contact when the bolts are tightened to a snug-tight condition.

203.03 – Welded Plate Girder Notes

Grade 36

101 All structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

102 All other structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

Grade 50

211 All structural steel for girder flanges, webs and all splice material shall conform to requirements of ASTM A709/A709M, Grade 50.

Weathering Steel

221 All structural steel for girder flanges, webs, stiffeners, separators, and all splice materials, shall conform to the requirements of ASTM A709/A709M, Grade 50W weathering steel.

122 Nuts, bolts, and washers used in the assembly of weathering steel shall be Type 3.

High Performance Steel 70W

225 All structural steel for girder flanges, webs, and all splice materials, shall conform to the requirements of ASTM A709/A709M-00, Grade 70W High Performance Steel.

226 All other structural steel shall conform to the requirements of ASTM A709/A709M, Grade 50W.

Fabrication

231 As an alternate design, all intermediate stiffener plates may be omitted if _____" web plates are used in place of _____" web plates shown.

232 Butt splices will be permitted for flange plates exceeding 60 feet in length. The locations of the splice shall be shown on the shop plans and will be subject to approval by the Engineer.

233 The contractor may eliminate any butt welded flange splice by extending the heavier of the two plates so connected. The contractor shall make any necessary adjustments in bearings and bearing seat elevations caused by flange plate changes. This shall be shown on shop plans and will be subject to approval by the Engineer. No change in contract price or quantites will be made for this substitution.

234 Butt splices will be permitted for web plates exceeding 60 feet in length. The location of the splice shall be shown on the shop plans and will be subject to approval by the Engineer.

235 During girder fabrication, the final camber tolerance shall not exceed those in Table 3.3 of A.W.S. "S" is the length of girder between splices.

131 All bearing stiffeners and girder ends, except at field splices, shall be vertical after final erection. All other stiffeners and all field splices shall be normal to the top flange.

132 During girder fabrication, the flanges at the splice must line up within 1/8” of parallel to the adjacent flanges without applying external force, before the splice is drilled.

136 Intermediate stiffener plates shall alternate on both sides of the web, at intervals shown, for interior girders. At exterior girders, intermediate stiffeners shall be placed only on the inside of the web plate.

Field Assembly

151 All fasteners shall be 7/8” ∅ high strength bolts, ASTM A325.

152 Field tack welding of form hangers or miscellaneous hardware to any part of the steel girder, except shear connectors, shall be prohibited.

153 When assembling the girders in the field, they shall be set according to the blocking diagram before any bolts are tightened to a snug-tight condition.

154 Field splices shall be clean and free of all foreign matter before field assembly. The plates shall be in full contact when the bolts are tightened to a snug-tight condition.

156 All high strength bolted connections shall include Director Tension Indicators, Squirter type. The turn-of-the-nut method is not allowed.

203.04 – Concrete Notes

3000 PSI

301 All other cast-in-place concrete shall be Class “47B” concrete, with a 28-day strength of 3000 psi.

4000 PSI

311 Concrete for slab, approach slabs and rails shall be Class “47BD”, with a 28-day strength of 4000 psi.

312 Concrete for slab, approach slabs, diaphragms and rails shall be Class “47BD”, with a 28-day strength of 4000 psi.

313 Concrete for slab, approach slabs and concrete barriers shall be Class “47BD”, with a 28-day strength of 4000 psi.

314 Concrete for slab, approach slabs, diaphragms and concrete barriers shall be Class “47BD”, with a 28-day strength of 4000 psi.

Reinforcement

321 All reinforcing steel shall be epoxy coated and conform to the requirements of ASTM A615/A615M, Grade 60 steel.

322 The minimum clearance, measured from the face of the concrete to the surface of any reinforcing bar, shall be 3”, except where otherwise noted.

323 All mechanical splices shall be epoxy coated or galvanized and develop a minimum of 125% of reinforcing bar yield strength. Splices shall be installed in accordance with the manufacturer’s recommendations. Samples of the mechanical splices shall be sent to NDOR Materials and Research Division for approval in accordance with the Materials Sampling Guide. Only approved mechanical splices shall be incorporated into the bridge. Mechanical splices will not be paid for directly, but will be considered subsidiary to the item “Epoxy Coated Reinforcing Steel”.

Prestress

331 Prestressed concrete girders must be at least 9 days old before they can be set on the bridge substructure. Surveying for shim shots, forming bridge deck or diaphragms and placing construction material on the girder is not allowed until the girders are at least 30 days old.

332 The contractor must provide any temporary intermediate diaphragms and/or bracing necessary to provide lateral and torsional stability for the girders during construction of the concrete slab. The temporary intermediate diaphragms/bracing shall be removed after the concrete slab has attained 75% of its design strength. The cost for furnishing, installing, and removing the temporary intermediate diaphragms and/or bracing shall be subsidiary to the pay item “Class 47BD-4000 Concrete for Bridges”.

Post-Tensioning

336 Post-Tensioned concrete girders must be at least 9 days old before they can be set on the Bridge substructure. Post-tensioning of the girders is not allowed before they attain the required design concrete strength. Surveying for shim shots, forming Bridge deck and placing construction material on the girder is not allowed before post-tensioning completion.

337 The contractor must provide any temporary intermediate diaphragms and/or bracing necessary to provide lateral and torsional stability for the girders during post-tensioning and construction of the concrete slab. The temporary intermediate diaphragms/bracing shall be removed after the concrete slab has attained 75% of its design strength. The cost for furnishing, installing, and removing the temporary intermediate diaphragms shall be subsidiary to the pay item “Class 47BD-4000 Concrete for Bridges”.

Integral Abutments

341 No form work, reinforcing steel, or construction loads shall be placed on the girders until the abutment concrete has set for 72 hours or reached a minimum compressive strength of 2000 psi.

203.05 – Structural Steel Notes

Material Specifications

401 Tie rods shall conform to ASTM A709/A709M Grade 36 Steel. Turnbuckles shall conform to ASTM A668/A668M, Class C.

402 After fabrication, nose angles at the piers shall be galvanized according to ASTM A123/A123M.

101 All structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

Payment

410 The item, “Structural Steel for Substructure”, shall include the tie rods and nose angles at the piers.

203.06 – Geology Sheet Notes

General

501 All pile spacing are given at the bottom of concrete.

502 Piers/Bents are designed for scour to elevation --------- ft. for 100-Year Flood
Piers/Bent are checked for scour to elevation ---------- ft. for 500-Year Flood

503 Abutment piling followed with the letter “B” shall be battered at X: 12.

504 Pier/Bent piling followed by the letter “B” shall be battered at X: 12.

505 Prefabricated cast steel points will be required on all HP piles in this structure. Approved manufacturers of prefabricated pile points are shown on the NDOR approved products list.

Sheet Piles

521 All steel sheet piling shall conform to ASTM A328/A328M steel and shall meet the following minimum requirements:

Section Length ..... ft.
Max. Section Depth..... in.
Min. Section Thickness ..... 0.30 in.
Section Modulus..... in^3/ft.

The contractor shall submit for review a shop plan of the sheet pile layout showing all pertinent dimensions, details, and section properties.

The pay quantity will be based on the sheet pile wall dimensions shown. The constructed wall length will be within $\pm$24 in. of the sheet pile wall dimensions shown.

Bearing Piles

531 Concrete piling shall be prestressed concrete piles, Type I.

532 For details of Concrete Piling, see Standard Plan 1C. In this Special Plan, the dimensions A, B, and C for Cast-in-Place piling will be:

At the Abutments “A” = , “B” = and “C” =

At the Piers/Bents “A” = , “B” = and “C” =

533 As an alternate, Cast-in-Place concrete piles may be used provided that the contractor shall be responsible for furnishing piling of sufficient length to obtain the penetration and bearing value required by the Geotechnical Engineer. All concrete for cast-in-place concrete piles shall be Class 47B with a minimum 28-day compressive strength of 3000 psi and 6” to 8” slump, the slump will be increased by adding plasticizer.

534 All concrete for prestressed concrete bearing piles shall be Class 47B-P or 47B-PHE with a minimum 28-day compressive strength of 5000 psi.

535 All exposed pipe piles shall be filled with concrete. This concrete shall be Class “47B” with a minimum 28-day compressive strength of 3,000 psi. This concrete shall be subsidiary to the pay item “Pipe Piling”.

Hammers

541 The borings, as logged on the plans, represent the character of the subsoil at the location indicated. No guarantee is made that the subsoil conditions vary uniformly between or outside the given location.

542 Figures beside the column of borings indicate the number of blows required to drive a standard penetrometer, of 2" O.D., the second and third six inches using a 140 lb. weight falling 30 in., in accordance with ASTM D1586 procedures.

Integral Abutments

550 All abutment piles, excluding wing pile, shall be started in holes predrilled to elevation _____. The minimum diameter of the holes for the HP___X___ pile shall be ____ in.

Piles shall be placed in the drilled holes, driven to design bearing and the void between the hole wall and the pile shall be backfilled with dry, clean sand. Predrilled holes shall not be backfilled until all abutment and wing piles are driven. Drilling, disposal of removed soil, and providing and backfilling with sand will be considered subsidiary to payment for Steel Piling.

All of the Drilled Shaft notes that are in the current BOPP Manual are missing.

Drilled Shafts

560 Pier columns will be supported on _____ diameter drilled shafts.

561 The drilled shafts shall be constructed using permanent casing. Permanent casing cutoff elevations are shown on the plans.

562 A construction joint shall be placed at the top of the permanent casing.

563 It is the responsibility of the contractor to verify the existing elevations and have a drilled shaft installation plan submitted and approved by the Geotechnical Engineer. Any proposed changes in the drilled shaft construction shall be included in the plan.

564 Concrete for drilled shafts shall be Class 47B with 28-day strength of 3000 psi.

565 All reinforcing steel in the drilled shafts shall be uncoated and conform to the requirements of ASTM A615/A615M.

566 The Geotechnical Section of the Materials and Research Division shall be notified prior to the excavation of the first drilled shaft.

567 The contractor shall perform the sonic testing on the first drilled shaft and provide to the Geotechnical Engineer the results of the test prior to constructing additional drilled shafts.

203.07 – Miscellaneous Notes

Abutment Drainage

601 All PVC pipe, galvanized wire screen, and miscellaneous drainage items at the abutments shall be considered subsidiary to the item “Subsurface Drainage Matting”.

602 Drainage matting shall wrap around the sloping drain pipe and extend 3 ft. along the wings.

Bridge Widening

621 All existing concrete coming in contact with the new work shall be thoroughly cleaned and roughened before placing new concrete.

622 All reinforcing steel encountered in breaking back existing concrete shall be thoroughly cleaned, straightened and extended into the new work a minimum of 24 in.

Elastomeric Bearings

631 Elastomeric bearing pads shall be AASHTO Grade 3 or higher and have a hardness *(shore A durometer)* of 60±5.

632 Elastomeric bearing pads, furnished and installed, shall not be paid for directly, but shall be subsidiary to “Precast/Prestressed Concrete Superstructure”.

633 Elastomeric bearing pads, furnished and installed, shall be measured for payment by the each. Payment shall be for the item, Elastomeric Bearing.

Mechanically Stabilized Earth (MSE) Walls

640 **MSE Wall Piling Notes:**

Abutment and grade beam piling may be driven before or after the construction of the MSE walls. If the piling are to be driven before the construction of the MSE wall, the Contractor shall place Corrugated Metal Pipe *(CMP)* sleeves around each pile prior to constructing the wall. If the piles are to be driven after the construction of the MSE wall, the Contractor shall place CMP sleeves at the exact location of each pile so that after the completion of the MSE wall the contractor can drive the piles through the sleeves. The CMP sleeves shall be maintained in a plumb position during construction of the MSE wall. Furnishing and placing of the CMP sleeves shall be included as part of the work for the MSE wall.

After all piling for the abutment and grade beam are driven and the MSE wall is complete, the Contractor shall fill the space between the piling and the CMP sleeves with dry, clean sand. Backfilling with sand shall be considered subsidiary to item HP ___ in x ___ lbs. Steel Piling.

Railroad

660 The top of rail elevations shall be verified in the field before beginning construction of the bridge. If the rail elevations are not as shown on the plans, the Project Manager shall contact the Bridge Division.

SBS Modified Base Sheet

670 SES Modified Base Sheet shall be modified bitumen roofing material, with a minimum thickness of 0.090 inches and a minimum weight of 60 lbs. per 100 square feet.

203.08 – Pay Item Policy

General

Designers are responsible for incorporating the bridge quantities under the proper pay items. Designers shall employ the Bridge Quantity Tolderance Policy *(see 2.1.6)* when calculating bridge quantities. Commonly used standard pay items are available as CAD cells and listed herein for your convenience. A complete listing of all pay items can be obtained from PS&E, through CMS mainframe or NDOR website under *Doing Business and Contractor's Corner.*

CMS Pay Item Database

There is a Standard English or Metric item file listing available on NDOR CMS mainframe. You can search these files for the current English or Metric standard items. It contains the Standard Item Number, Unit of Measure, Specification Reference *(if shown)* and Description.

Type the following at a CMS prompt: 97stdit xxxxx for English 97 Spec.

The word, words, partial word, or numbers you wish to search for are represented by xxxxx. You may use upper or lower case or a combination. Spaces and punctuation must also be taken into consideration. Remember, you are searching for a string of letters and/or numbers.

When you enter your search criteria, it will list all the items that meet this requirement. **Caution!** If you use too general a term, you may get a long listing. A long list of items may not fit onto one screen. If this occurs, you will notice the message "Holding" in the lower right of your screen. As with other CMS applications, use your PA2 key to continue.

This file shall be updated on Friday afternoons with all the new standard items. Contact the Section Leader if the standard item you need does not appear on this listing.

Structure Removal

The pay item Remove Structure at Station _____ *(Each #6040.00)* shall not be shown in the Bridge Plans. However, this pay item must always be included in the Estimate of Quantities submitted by the Assistant Bridge Engineer. Payment for this item shall be included in the *(Roadway)* Summary of Quantities Sheet. The Bridge Division does not consider this to be a part of the Bridge Plan, and it may or may not be a part of Group 6 work in the Contract. This pay item is in the NDOR Standard Specifications, Section 203 *(Removal of Structures and Obstructions).*

Preparation of Bridge

Payment for Preparation of Bridge at Sta. _____ is described in the NDOR Standard Specifications, Section 704.

Standard Pay Items

Note	Category		Unit of Measure	Item Number
	Preparation			
001	Preparation of Bridge at Station _____		Each	6030.00
	Excavation			
010	Abutment No. 1 Excavation		Lump Sum	6000.10
	Abutment No. 2 Excavation		Lump Sum	6000.11
011	Pier No. 1 Excavation	*(used for Dry exc.)*	Lump Sum	6000.20
	Pier No. 2 Excavation		Lump Sum	6000.21
	Pier No. 12 Excavation		Lump Sum	6000.31
	Pier No. 1 Excavation	*(used for Dry exc.)*	Lump Sum	6000.60
	Pier No. 2 Excavation		Lump Sum	6000.61
	Pier No. 15 Excavation		Lump Sum	6000.74
012	Bent No. 1 Excavation	*(used for WET exc.)*	Lump Sum	6001.00
	Bent No. 2 Excavation		Lump Sum	6001.01
	Bent No. 1 Excavation	*(used for WET exc.)*	Lump Sum	6001.50
	Bent No. 2 Excavation		Lump Sum	6001.51
	Bent No. 3 Excavation		Lump Sum	6001.52
	Bent No. 4 Excavation		Lump Sum	6001.53
013	Excavation *(Established)* Quantity		Cu.Yd.	1010.01
014	Granular Backfill		Cu.Yd.	8091.00
	Concrete			
020	Class 47B-3000 Concrete for Bridges		Cu.Yd.	6010.22
	Abutments	Cu.Yd.		
	Piers	Cu.Yd.		
021	Class 47B-3000 Concrete for Bridges		Cu.Yd.	6010.22
	Abutments	Cu.Yd.		
	Bents	Cu.Yd.		
022	Class 47BD-4000 Concrete for Bridges		Cu.Yd.	6010.26
	Slab	Cu.Yd.		
	Haunch	Cu.Yd.		
	Concrete Barrier	Cu.Yd.		
023	Class 47BD-5000 Concrete for Bridges		Cu.Yd.	6010.28
024	Precast/Prestressed Concrete Superstructure at Station _____		Lump Sum	6011.11
	Girders		Cu.Yd.	
025	Precast-Prestressed/Post-Tensioned Concrete Superstructure at Station _____		Lump Sum	6011.12
	Girders		Cu.Yd.	
027	Concrete for Pavement Approaches Class 47BD-4000		Cu.Yd.	3050.15
	Slab	Cu.Yd.		
	Concrete Rail	Cu.Yd.		

Standard Pay Items

Note	Category		Unit of Measure	Item Number
	Concrete *(continued)*			
027B	Concrete for Pavement Approaches Class 47BD-4000		Cu.Yd.	3050.15
	Slab	Cu.Yd.		
	Concrete Barrier	Cu.Yd.		
	Reinforcing Steel			
030	Epoxy Coated Reinforcing Steel		Lbs.	6131.50
030B	Reinforcing Steel for Bridge		Lbs.	6020.00
031	Epoxy Coated Reinforcing Steel		Lbs.	6131.50
	Slab	Lbs.		
	Concrete Rail	Lbs.		
	Abutments	Lbs.		
	Piers	Lbs.		
031B	Epoxy Coated Reinforcing Steel		Lbs.	6131.50
	Slab	Lbs.		
	Concrete Barrier	Lbs.		
	Abutments	Lbs.		
	Piers	Lbs.		
032	Epoxy Coated Reinforcing Steel		Lbs.	6131.50
	Slab	Lbs.		
	Concrete Rail	Lbs.		
	Abutments	Lbs.		
	Bents	Lbs.		
032B	Epoxy Coated Reinforcing Steel		Lbs.	6131.50
	Slab	Lbs.		
	Concrete Barrier	Lbs.		
	Abutments	Lbs.		
	Bents	Lbs.		
033	Epoxy Coated Reinforcing Steel for Pavement Approaches		Lbs.	3051.10
	Slab	Lbs.		
	Concrete Rail	Lbs.		
033B	Epoxy Coated Reinforcing Steel for Pavement Approaches		Lbs.	3051.10
	Slab	Lbs.		
	Concrete Barrier	Lbs.		
	Structural Steel			
040	Steel Superstructure at Station _____		Lump Sum	6071.10
	Girders	Lbs.		
	Separators & Misc.	Lbs.		
	Total	Lbs.		
	(Welded plate girder)		Lump Sum	6071.11
	(Rolled beam)		Lump Sum	6071.12

Standard Pay Items

Note	Category	Unit of Measure	Item Number
	Structural Steel *(continued)*		
(Welded plate/Rolled beam combination)		Lump Sum	6071.13
041	Structural Steel for Superstructure	Lbs.	6081.00
042	Steel Diaphragms	Each	6095.00
	Substructure		
050	Structural Steel for Substructure	Lbs.	6080.00
	Piling		
060	HP 10 in. x 42 lbs. Steel Piling	Lin. Ft.	6210.12
061	HP 12 in. x 53 lbs. Steel Piling	Lin. Ft.	6210.14
062	Concrete Piling	Lin. Ft.	6200.00
063	Concrete Sheet Piling	Sq. Ft.	6200.00
064	Steel Sheet Piling	Sq. Ft.	6310.00
065	Pipe Piling	Lin. Ft.	6210.50
066	Test Pile	Each	6251.00
			6251.01
			6251.02
			6251.03
067	Drilled Shaft	Lin. Ft.	6251.50
068	Rock Socket	Lin. Ft.	6251.40
	Bearings		
070	Fixed Bearing Device, Type I	Each	6005.80
071	Guided Bearing Device, Type II	Each	6005.85
072	Non-Guided Bearing Device, Type III	Each	6005.90
073	Expansion Bearing, TFE Type	Each	6005.78
075	Fixed Bearing	Each	6005.83
077	Bearing Device Replacement	Each	6616.65
078	Elastomeric Bearing	Each	6005.60

Standard Pay Items

Note	Category	Unit of Measure	Item Number
	Riprap		
080	Broken Concrete Riprap	Tons	6104.00
081	Rock Riprap, Type “A”	Tons	6105.01
082	Rock Riprap, Type “B”	Tons	6105.02
083	Rock Riprap, Type “C”	Tons	6105.03
	Drainage		
090	Drainage System at Sta.	Each	6415.00
091	Floor Drains	Each	6100.00
092	Subsurface Drainage Matting	Sq. Yd.	6139.50
	Expansion Joints		
102	Deck Joint Seal, Type IV	Lin. Ft.	6005.13
103	Strip Seal	Lin. Ft.	6610.45
104	Precompressed Polyurethane Foam Joint	Lin. Ft.	6005.35
	Railing		
111	Pedestrian Barrier Rail	Lin. Ft.	6401.00
112	Pedestrian Railing *(Chain Link Type)*	Lin. Ft.	6404.00 6404.02
113	6 Ft. Pedestrian Railing *(Chain Link Type)*	Lin. Ft.	6404.16
114	6 Ft. Pedestrian Railing *(Chain Link Type-Vinyl Coated)*	Lin. Ft.	6404.26
	Silica Fume Overlay		
130	Concrete for Overlay – SF	Cu. Yd.	6016.02
131	Class I Repair	Sq. Yd.	6007.01
132	Class II Repair	Sq. Yd.	6007.02
133	Class III Repair	Sq. Yd.	6007.03
134	Placing, Finishing, and Curing Concrete Overlay – SF	Sq. Yd.	6008.40

Standard Pay Items

Note	Category	Unit of Measure	Item Number
	Shoring		
140	Bridge Shoring	Lump Sum	6510.60
141	Temporary Bridge Shoring	Lump Sum	6510.55
Miscellaneous			
200	Painting Structure at Sta. _____	Lump Sum	6430.00 6430.01 6430.02 6430.03
201	Concrete Coating at Sta.	Lump Sum	6602.31
202	Riprap Filter Fabric	Sq. Yd.	1043.50
204	Concrete Slope Protection	Sq. Yd.	6107.00
206	1.5 in. Conduit in Bridge	Lin. Ft.	6601.15
208	Temporary Supports	Each	6614.10

SECTION 204: CONCRETE REINFORCEMENT

204.01 – Concrete Reinforcement Policy

General

All plans shall specify epoxy coated reinforcing steel which conforms to the requirements of ASTM A615, Grade 60, as stated in the general note #321. Epoxy coating should be indicated in the notes on the front sheet and in the Bill of Bars sheets. The only exception; prestressed I, double tee and IT girders reinforcement *shall not* be epoxy coated. See prestressed girder policies.

There are other reinforcement notes included with the standard concrete notes in Chapter 2 that may be required on the front sheet of the Plans.

Bar Clearance

The minimum clearance, in inches, measured from the face of the concrete to the surface of any reinforcing bar will be as follows:

Concrete slabs:	Top of Slab	= 2 1/2 " $\pm$ 1/4"
	Bottom of Slab	= 1" $\pm$ 1/4"
	Edge of Slab	= 3"
Open concrete curbs:	All sides	= 2"
	Top of Post	= 3"
New Jersey type curbs:	Top and sides	= 2"
Elevated girder seats:	Top and sides	= 3"
Piers and bents:	All sides	= 3"
Abutments and wings:	All sides	= 3"
Approach slabs:	Top of slab	= 2 1/2"
	Bottom of slab	= 3"
Grade and anchor beams:	All sides	= 3"

Bar Marks

Bar marks for all reinforcing bars will begin with a letter(s) to indicate their position in the structure. As stated in the Bill of Bars base sheet, the following designations should be used for most reinforcement. However, other letters or combinations may be used for more complex layouts.

B – Bents **P** – Piers **A** – Abutments, wings & grade beams
S – Bridge slab and rail or curb sections in/on bridge deck
N – Approaches and rail or curb sections in/on approaches

The first number following the letter indicates the bar size (Note: the first two numbers for bar #10 and bigger). The last two digits are used to uniquely identify the bar being specified and should be shown in sequential order in the Bill of Bars Sheet. The following series of numbers have been designated to be associated with specific types of reinforcement:

01 thru 49	General reinforcing
70 thru 79	Light pole base reinforcing
90 thru 99	Barrier or rail reinforcing

In addition, when calling out bars on the plans, the quantity of identical bars used at a given location should be indicated with a hyphen preceeding the bar mark.

Example: 12-S501

Bill of Bars

There is a bill of bars base sheet *(BILBAR#, see Chapter 6)* that will show the bending diagrams for the entire bill of bars shown in the Plans. This sheet will also contain the bill of bars for the approach slabs. Phased projects will indicate the number of bars in each phase in the bill of bars.

- The bill of bars for the bridge elements will be shown next to the detailed drawings. A separate bill of bars for each bridge element, such as: the abutment, pier *(bent),* bridge deck and the slab for a slab bridge; will be shown on the respective Plan Sheet where they are detailed. For example, if one detail is used for both abutments in the Plans, two bill of bars will be required. The following cells are available in the General Bridge cell library for detailing on the Plan Sheets.

Bill of Bars														
	Mark	No.	Length	Type	"A"	"B"	"C"	"D"	"E"	"F"		Pin	Hook	Lbs.
											Subtotal	=	Lbs.	
NOTE: For pin diameters, hook lengths & bending diagrams, see Sheet of											TOTAL	=	Lbs.	

AC=BOB

Bill of Bars															WEIGHT
	Mark	Number of Bars		Length	Type	"A"	"B"	"C"	"D"	"E"	"F"		Pin	Hook	Lbs.
		Phase 1	Phase 2												
												Subtotal	=	Lbs.	
NOTE: For pin diameters, hook lengths & bending diagrams, see Sheet of												TOTAL	=	Lbs.	

AC=PBOB

- **Bar Lengths**
  The Bridge Division's general policy for calculating bar lengths will be based on 40 ft. *(12 m),* with a lap splice provided for bars exceeding that length. Bar lengths should be rounded to the nearest inch.

- **Bar Lengths**
  When bar sets are needed, a single bar number shall be used for the entire set. A minimum, maximum and an average bar length will be shown for each set. Average length for bar sets should be rounded to half-inch increments. The cell BOBST is available in the General Bridge cell library.

Bar Sets				
Mark	**Max. Length**	**Min. Length**	**No. of Sets**	**Bars per Set**

AC=BOBST

- **Bar Lengths**
  All bending diagram dimensions will be given as out-to-out based on the pin diameters for Grade 60 bars. Bill of Bars will show the required pin diameter and hook length according to primary stress or stirrup requirements.

204.02 - Rebar Data Table

The following table will be used to calculate reinforcement quantities and may be used as a design aid.

English			
Mark	**Dia. (in.)**	**Area ($in.^2$)**	**Weight (lbs./ft.)**
#3	0.375	0.11	0.376
#4	0.500	0.20	0.668
#5	0.625	0.31	1.043
#6	0.750	0.44	1.502
#7	0.875	0.60	2.044
#8	1.000	0.79	2.670
#9	1.125	1.00	3.400
#10	1.270	1.27	4.303
#11	1.410	1.56	5.313
#14	1.693	2.25	7.650
#18	2.257	4.00	13.60

Development and Lap Length Definitions for Deformed Bars in Tension

The following definitions are repeated from the AASHTO 17th Edition.

Development Length Ld

The development length Ld is the length of embedded reinforcement required to develop the design strength of the reinforcement at a critical section.

The development length Ld shall be computed as the product of the basic development length defined as AASHTO Standard Specifications Article 8.25.1 and the applicable modification factor or factors defined in Article 8.25.2 and 8.25.3.

Top Bar

Horizontal reinforcement so placed that more than one foot of concrete is cast below the reinforcement.

Class A Splice *(lap = 1.0 x Ld)*

Used in a region of low tensile stress when 75% or less of the bars are lap spliced within the required lap length.

Class B Splice *(lap = 1.3 x Ld)*

Used in a region of low tensile stress when more than 75% of the bars are lap spliced within the required lap length ***or*** in a region of high tensile stress when 50% or less of the bars are lap spliced wtihin the required lap length.

Class C Splice *(lap = 1.7 x Ld)*

Used in a region of high tensile stress when more than 50% of the bars are lap spliced within the required lap length.

Low Tensile Stress Region

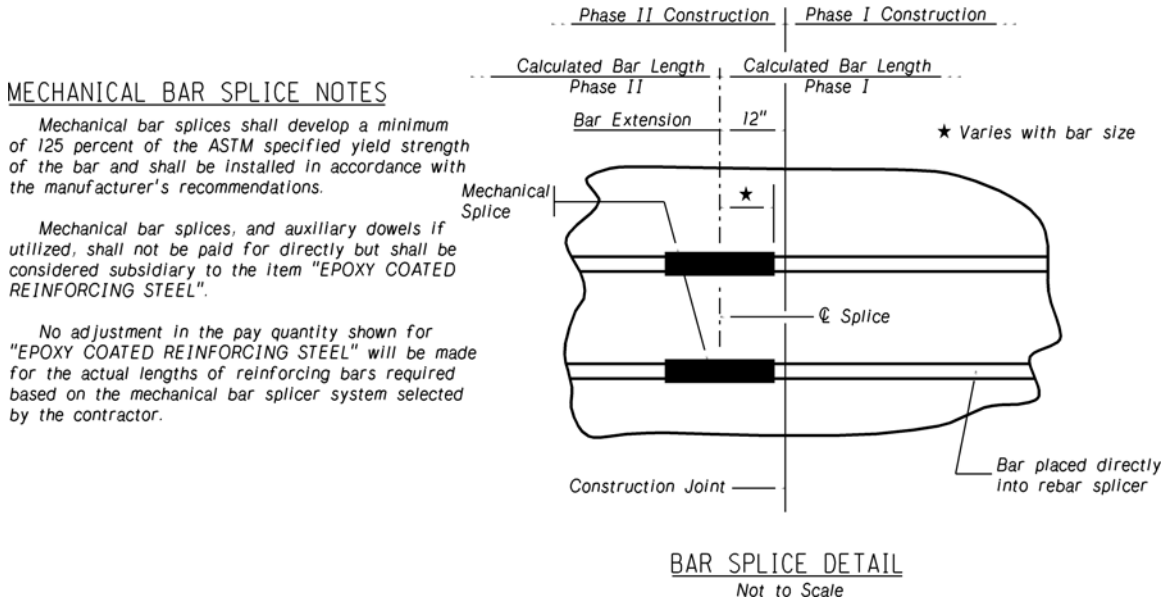
Location where the area of reinforcement provided is equal or greater than twice the area required for strength.

High Tensile Stress Region

Location where the area of reinforcement provided is less than twice the area required for strength.

Mechanical Bar Splice

Mechanical bar splice assemblies shall develop at least 125 percent of the yield strength of reinforcing bar in tension or compression. Standard note **#323** shall be included on the front sheet and the following cell **AC=MSPLIC** shall be shown on the plans where the mechanical splices are required.



AC=MSPLIC

204.03 - Bars Development/Splices Tables

The following tables were developed using AASHTO 17th Edition for deformed bars grade 60 in tension. Lightweight concrete and reduction factors are not included. Hook information for reinforcement is available on the Bill of Bars sheets.

3000 PSI Concrete

	Development Length						Tension Lap Splices									Tension Lap Splice for Top Bars								
	Others			Top Bars			Non-Epoxy	Epoxy Coated Bars								Non-Epoxy	Epoxy Coated Bars							
	Ldb	1.15	1.5	Lb	1.15	1.5*	Ld	1.15			1.5					Ld	1.15			1.5*				
				1.4*												1.4	1.4			1.4*				
Bar							A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
3	12	12	14	13	14	15	12	12	15	12	13	18	14	18	23	13	16	21	14	19	25	15	20	26
4	12	14	18	17	19	20	12	16	20	14	18	23	18	23	31	17	22	29	19	25	33	20	27	35
5	15	17	23	21	24	26	15	20	26	17	22	29	23	29	38	21	27	36	24	31	41	26	33	43
6	19	22	29	27	31	33	19	25	33	22	29	38	29	38	49	27	35	46	31	40	53	33	43	56
7	26	30	39	37	42	45	26	34	45	30	39	51	39	51	67	37	48	63	42	55	72	45	58	76
8	35	40	52	48	56	59	35	45	59	40	52	68	52	68	88	48	63	82	56	72	95	59	77	100
9	44	50	66	61	71	74	44	57	74	50	66	86	66	85	112	61	80	104	71	92	120	74	97	127
10	56	64	83	78	90	95	56	72	95	64	83	109	83	109	142	78	101	132	90	116	152	95	123	161
11	68	79	103	96	110	116	68	89	116	79	102	134	103	133	174	96	124	163	110	143	187	116	151	198

4000 PSI Concrete

	Development Length						Tension Lap Splices									Tension Lap Splice for Top Bars								
	Others			Top Bars			Non-Epoxy	Epoxy Coated Bars								Non-Epoxy	Epoxy Coated Bars							
	Ldb	1.15	1.5	Lb	1.15	1.5*	Ld	1.15			1.5					Ld	1.15			1.5*				
				1.4*												1.4	1.4			1.4*				
Bar							A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
3	12	12	14	13	14	15	12	12	15	12	13	18	14	18	23	13	16	21	14	19	25	15	20	26
4	12	14	18	17	19	20	12	16	20	14	18	23	18	23	31	17	22	29	19	25	33	20	27	35
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6	18	21	27	25	29	31	18	23	31	21	27	35	27	35	46	25	33	43	29	38	49	31	40	52
7	23	26	34	32	37	39	23	30	39	26	34	45	34	44	58	32	41	54	37	48	62	39	50	66
8	30	34	45	42	48	51	30	39	51	34	45	59	45	58	76	42	55	71	48	63	82	51	66	87
9	34	44	57	53	61	65	38	49	85	44	57	74	57	74	97	53	69	90	61	79	104	65	84	110
10	48	55	72	67	78	82	48	63	82	55	72	94	72	94	123	67	88	115	78	101	132	82	107	139
11	59	68	89	83	95	101	59	77	101	68	89	116	89	115	151	83	108	141	95	124	162	101	131	171

5000 PSI Concrete

	Development Length						Tension Lap Splices									Tension Lap Splice for Top Bars								
	Others			Top Bars			Non-Epoxy	Epoxy Coated Bars								Non-Epoxy	Epoxy Coated Bars							
	Ldb	1.15	1.5	Lb	1.15	1.5*	Ld	1.15			1.5					Ld	1.15			1.5*				
				1.4*												1.4	1.4			1.4*				
Bar							A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
3	12	12	14	13	14	15	12	12	15	12	13	18	14	18	23	13	16	21	14	19	25	15	20	26
4	12	14	18	17	19	20	12	16	20	14	18	23	18	23	31	17	22	29	19	25	33	20	27	35
5	15	17	23	21	24	26	15	20	26	17	22	29	23	29	38	21	27	36	24	31	41	26	33	43
6	18	21	27	25	29	31	18	23	31	21	27	35	27	35	46	25	33	43	29	38	49	31	40	52
7	21	24	32	29	34	36	21	27	36	24	31	41	32	41	54	29	38	50	34	44	57	36	46	61
8	27	31	40	38	43	46	27	35	46	31	40	52	40	52	68	38	49	64	43	56	73	46	59	77
9	34	39	51	48	55	58	34	44	58	39	51	66	51	66	87	48	62	81	55	71	93	58	75	98
10	43	50	65	60	69	73	43	56	73	50	64	84	65	84	110	60	78	103	69	90	118	73	95	125
11	53	61	79	74	85	90	53	69	90	61	79	104	79	103	135	74	96	126	85	111	145	90	117	153

* For Development Length Only, a maximum of 1.7 is used for the product of Top bar and Epoxy coating factors.

For definitions of Class A, B, and C splices and the applicable factors, see Section 204.02.

WELDED WIRE FABRIC TABLE

W & D Size		Nominal diameter, in.	Nominal area, $in.^2$	Nominal weight, lb./ft.
Plain	Deformed			
W31	D31	0.628	0.310	1.054
W30	D30	0.618	0.300	1.020
W28	D28	0.597	0.280	0.952
W26	D26	0.575	0.260	0.934
W24	D24	0.553	0.240	0.816
W22	D22	0.529	0.220	0.748
W20	D20	0.504	0.200	0.680
W18	D18	0.478	0.180	0.612
W16	D16	0.451	0.160	0.544
W14	D14	0.422	0.140	0.476
W12	D12	0.390	0.120	0.408
W11	D11	0.374	0.110	0.374
W10.5		0.366	0.105	0.357
W10	D10	0.356	0.100	0.340
W9.5		0.348	0.095	0.323
W9	D9	0.338	0.090	0.306
W8.5		0.329	0.085	0.289
W8	D8	0.319	0.080	0.272
W7.5		0.309	0.075	0.255
W7	D7	0.298	0.070	0.238
W6.5		0.288	0.065	0.221
W6	D6	0.276	0.060	0.204
W5.5		0.264	0.055	0.187
W5	D5	0.252	0.050	0.170
W4.5		0.240	0.045	0.153
W4	D4	0.225	0.040	0.136
W3.5		0.211	0.035	0.119
W3		0.195	0.030	0.102
W2.9		0.192	0.029	0.098
W2.5		0.178	0.025	0.085
W2		0.159	0.020	0.068
W1.4		0.135	0.014	0.049

SECTION 205: SLOPE PROTECTION DETAILS

205.01 - Concrete Slope Protection Policy

General Criteria

- Concrete slope protection shall be used to protect slopes and provide aesthetics.
- Concrete Slope protection shall be specified on the plans as indicated on the data sheet.

Material Requirements

- Concrete for the slope protection shall be Class 47B-3000
- Reinforcement for Concrete Slope Protection shall be 6X6-W2.9xW2.9 welded wire fabric with 6 in. lap splices.
- All materials shall conform to the requirements of Table 908.01 of Nebraska Standard Specifications for Highway Construction

Guidelines for Concrete Slope Protection

- Slope shall match grading cross-section
- Detail “A” generally located at half or third points with 16 ft.± spacing.
- Control joints – Detail B – are usually spaced at 4 ft. to 8 ft. centers across the slope.
- Detail B-B shall be used on the sides of the slope protection.
- Detail D-D shall be used on the sides of skewed slope protection when excessive drainage from deck drain may cause erosion. Designers should consult with section leader in this situation.

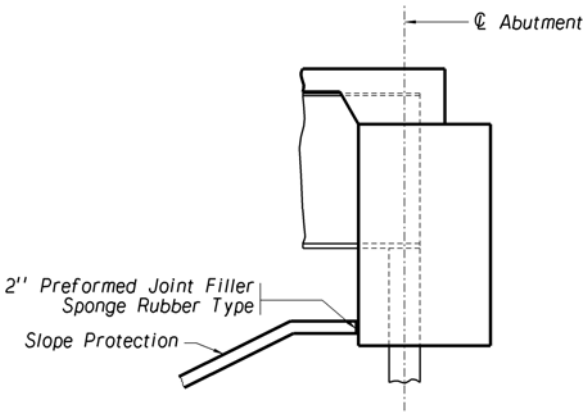
Method of Measurements

Concrete Slope Protection shall be measured by the square yard of finished surface area including turndowns.

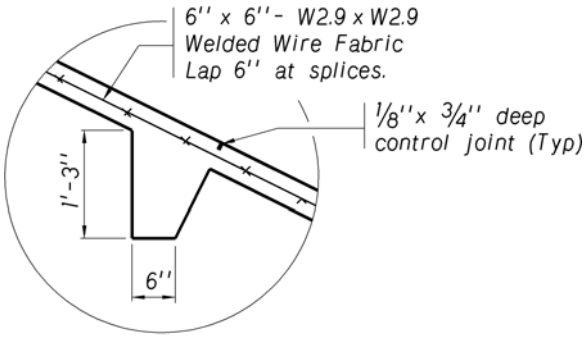
Basis of Payment

Concrete Slope Protection will be paid for as “Concrete Slope Protection Sq. Yd.”

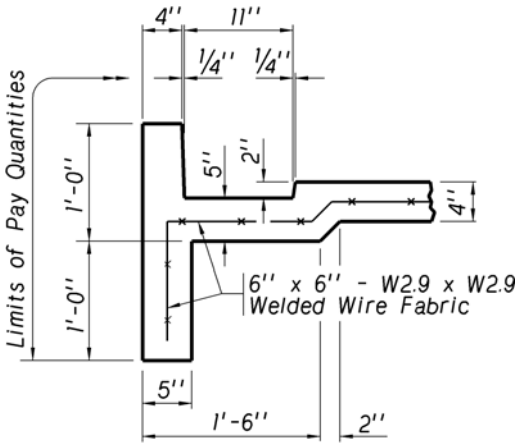
CONCRETE SLOPE PROTECTION DETAILS



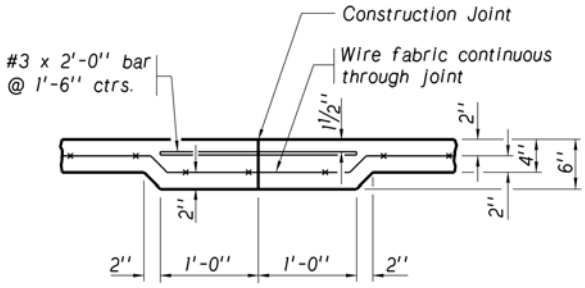
SLOPE PROTECTION AT ABUTMENT



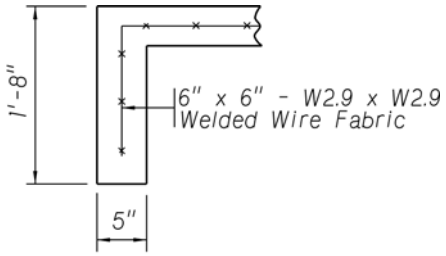
DETAIL ''A''



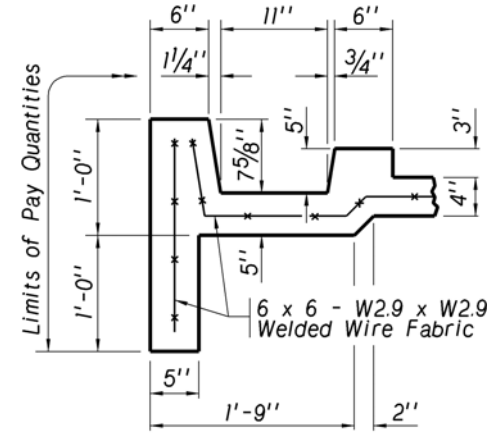
SECTION B-B



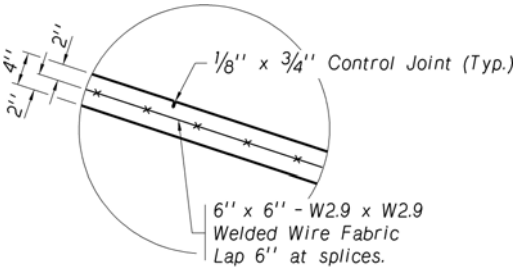
OPTIONAL CONSTRUCTION JOINT



SECTION C-C



SECTION D-D



DETAIL "B"

205.02 – Riprap Policy

General Criteria

Riprap will be specified on the Plans as indicated on the Data Sheet. Riprap must be placed along the abutment wings, as stated in the Wing Policy, and must be added if it is not specified in the Data Sheet riprap layout.

Broken Concrete

Designers must verify the volume of broken concrete riprap available on the project. Sources may include the existing structure, other locations on the proejct, or other locations specified by the District. The Plans or Special Provisions must specify the designated areas where the broken concrete riprap may be obtained by the Contractor. If there is not enough existing concrete to provide the required riprap specified on the Data Sheet, the Designer should request the Hydrology Section to modify their riprap layout or specify additional rock riprap *(Type A, B, or C).*

Broken Concrete Volume

The volume of broken concrete available to be used as riprap will be the actual unbroken *(existing)* concrete volume. This will allow for approximately 30% losses when the concrete is placed as broken concrete riprap. The in-place density of broken concrete riprap will be 1.35 Ton/CY. See Rock Riprap for calculation of quantities.

Bituminous Overlays

The following paragraph must be included in the Special Provisions; normally in Preparation of Bridge at Station _____.

> Bituminous material may not be used as broken concrete riprap. Concrete structures that have a bituminous overlay must have the overlay removed prior to removal of the structure if the concrete is to be used as riprap.

Rock Riprap

The in-place density of rock riprap *(Type A, B, or C)* will be 1.35 Ton/CY. Therefore, the quantity of riprap should be based on the following equation:

(Riprap Volume) CY x 1.35 Ton/CY = Riprap Quantity (Ton)

Payment

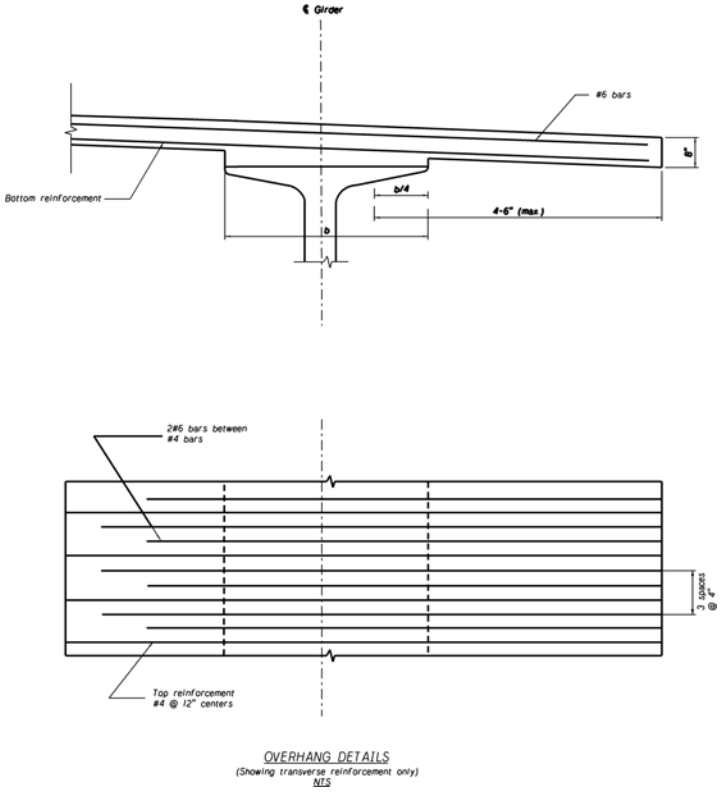
NDOR Standard Specifications, Section 905 states that rock riprap will be paid for as Rock Riprap, Type A, B, or C *(Ton).* Section 906 states that broken concrete riprap will be paid for as Broken Concrete Riprap *(Ton).*

SECTION 206: LOAD AND RESISTANCE FACTOR DESIGN

206.01 - LRFD Design Policy

General

- Ductility factor (n_D), Redundancy factor (n_R) and Operational Importance factor (n_I) shall be taken as 1.0. Any deviation from this policy should be shown on the data sheet or approved by the Assistant Bridge Engineer.
- The following deflection limits shall be used to control deflection:
  - Vehicular load, general span/800
  - Vehicular and/or pedestrian loads span/1000
  - Vehicular load on cantilever arms span/300
  - Vehicular load and/or pedestrian loads on cantilever arms span/375
- For piers adjacent to railroads, crash walls shall be provided only for clearances less than 25 feet. Piers shall be checked for collision force.
- Bridge designers shall provide the geotechnical engineer with pile loading using:
  - LFD design using HS25 loading.
  - LRFD design at service limit state *(unfactored).*
- For prestressed Inverted Tee girders, the distribution factors of live load per lane shall be S/11 for moment and S/5.5 for shear, where S is the beam spacing in feet. These factors are based on a research done by the University of Nebraska.
- For slab overhang up to 4'-6"
  - Minimum slab thickness shall be 8".
  - Reinforcement for slab overhang shall be 2-#6 bars at 4" centers placed between top slab reinforcement. The #6 bars shall be fully developed but shall not be terminated in the same section. *(See details below.)*



OVERHANG DETAILS
(Showing transverse reinforcement only)
NTS

- Designers shall use AASHTO standard specifications to determine bearing's anchor bolt embedment.
- For up to 5-girder bridges, minimize overhang and if the exterior girder controls, use exterior girder design for all girders. For more than 5-girder bridges, minimize the overhang and use the interior girder design for the entire bridge.

206.02 - LRFD – Bars Development/Splices Tables

The following tables wer developed using AASHTO LRFD 3rd Edition for deformed Bars grade 60 in Tension. Lightweight concrete and reduction factors are not included. Hook information for reinforcement is available on the Bill of Bars sheets.

3000 PSI Concrete

Development Length							Tension Lap Splices									Tension Lap Splice for Top Bars								
	Others			Top Bars			Non-Epoxy	Epoxy Coated Bars								Non-Epoxy	Epoxy Coated Bars							
	Ldb	1.2	1.5	Lb	1.2	1.5*	Ld			1.2			1.5			Ld			1.2			1.5*		
				1.4*												1.4			1.4			1.4*		
Bar							A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
3	12	12	14	13	15	15	12	12	15	12	14	18	14	18	23	13	16	21	15	20	26	15	20	26
4	12	14	18	17	20	20	12	16	20	14	19	24	18	23	31	17	22	29	20	26	34	20	27	35
5	15	18	23	21	25	26	15	20	26	18	23	31	23	29	38	21	27	36	25	33	43	26	33	43
6	19	23	29	27	32	33	19	25	33	23	30	39	29	38	49	27	35	46	32	42	55	33	43	56
7	26	32	39	37	44	45	26	34	45	39	41	54	39	51	67	37	48	63	44	57	75	45	58	75
8	35	42	52	48	58	59	35	45	59	42	54	71	52	68	88	48	63	82	58	76	99	59	77	100
9	44	53	66	61	74	74	44	57	74	53	68	89	66	85	112	61	80	104	74	96	125	74	97	127
10	56	67	83	78	93	95	56	72	95	67	87	114	83	109	142	78	101	132	93	122	159	95	123	161
11	68	82	103	96	115	116	68	89	116	82	107	139	103	133	174	96	124	163	115	149	195	116	151	198

4000 PSI Concrete

Development Length							Tension Lap Splices									Tension Lap Splice for Top Bars								
	Others			Top Bars			Non-Epoxy	Epoxy Coated Bars								Non-Epoxy	Epoxy Coated Bars							
	Ldb	1.2	1.5	Lb	1.2	1.5*	Ld			1.2			1.5			Ld			1.2			1.5*		
				1.4*												1.4			1.4			1.4*		
Bar							A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
3	12	12	14	13	15	15	12	12	15	12	14	18	14	18	23	13	16	21	15	20	26	15	20	26
4	12	14	18	17	20	20	12	16	20	14	19	24	18	23	31	17	22	29	20	26	34	20	27	35
5	15	18	23	21	25	26	15	20	26	18	23	31	23	29	38	21	27	36	25	33	43	26	33	43
6	18	22	27	25	30	31	18	23	31	22	28	37	27	35	46	25	33	43	30	39	51	31	40	52
7	23	27	34	32	38	39	23	30	39	27	36	46	34	44	58	32	41	54	38	50	65	39	50	66
8	30	36	45	42	50	51	30	39	51	36	47	61	45	58	76	42	55	71	50	65	86	51	66	87
9	38	46	57	53	64	65	38	49	65	46	59	77	57	74	97	53	69	90	64	83	108	65	84	110
10	48	58	72	67	81	82	48	63	82	58	75	98	72	94	123	67	88	115	81	105	138	82	107	139
11	59	71	89	83	99	101	59	77	101	71	92	121	89	115	151	83	108	141	99	129	169	101	131	171

5000 PSI Concrete

Development Length							Tension Lap Splices									Tension Lap Splice for Top Bars								
	Others			Top Bars			Non-Epoxy	Epoxy Coated Bars								Non-Epoxy	Epoxy Coated Bars							
	Ldb	1.2	1.5	Lb	1.15	1.5*	Ld			1.2			1.5			Ld			1.2			1.5*		
				1.4*												1.4			1.4			1.4*		
Bar							A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
3	12	12	14	13	15	15	12	12	15	12	14	18	14	18	23	13	16	21	15	20	26	15	20	26
4	12	14	18	17	20	20	12	16	20	14	19	24	18	23	31	17	22	29	20	26	34	20	27	35
5	15	18	23	21	25	26	15	20	26	18	23	31	23	29	38	21	27	36	25	33	43	26	33	43
6	18	22	27	25	30	31	18	23	31	22	28	37	27	35	46	25	33	43	30	39	51	31	40	52
7	21	25	32	29	35	36	21	27	36	25	33	43	32	41	54	29	38	50	35	46	60	36	46	61
8	27	32	40	38	45	46	27	35	46	32	42	55	40	52	68	38	49	64	45	59	77	46	59	77
9	34	41	51	48	57	58	34	44	58	41	53	69	51	66	87	48	62	81	57	74	97	58	75	98
10	43	52	65	60	72	73	43	56	73	52	67	88	65	84	110	60	78	103	72	94	123	73	95	125
11	53	64	79	74	89	90	53	69	90	64	83	108	79	103	135	74	96	126	89	116	151	90	117	153

* For Development Length Only, a maximum of 1.7 is used for the product of Top bar and Epoxy coating factors.

For definitions of Class A, B, and C splices and the applicable factors, see Section 204.02.

Chapter 3
Bridge Superstructure

SECTION 301: GENERAL SUPERSTRUCTURE

301.01 – Deck Design Policy

General Deck Criteria

Concrete decks supported on longitudinal girders – Except the Inverted Tee – shall be designed using the empirical deck design in accordance with the current AASHTO LRFD Bridge Design Specifications. Concrete design strength (f'c) shall be 4000 psi. Stay-in-place concrete deck forms will not be allowed.

Empirical Deck Design

Deck Thickness

Deck thickness shall be as stated below, based on the effective span length between girders. Typical empirical deck reinforcement shall be as stated in the following paragraphs and shall not change with different deck thicknesses.

Effective Span	Deck Thickness
Up to 9'-6"	7.50 in.
9'-6" to 10'-6"	8.00 in.
10'-6" to 11'-6"	8.50 in.

Transverse Bars

The clear cover for transverse bars shall be as stated in the Concrete Reinforcement Policy. The transverse bar spacing shall be measured along the CL roadway and placed perpendicular to girders with bar sets provided at the end of floor. Top bars shall be #4 at 12" centers with the first space being 6". This will stagger the top and bottom transverse bar layout. The bottom bars shall be #5 bars at 12" centers.

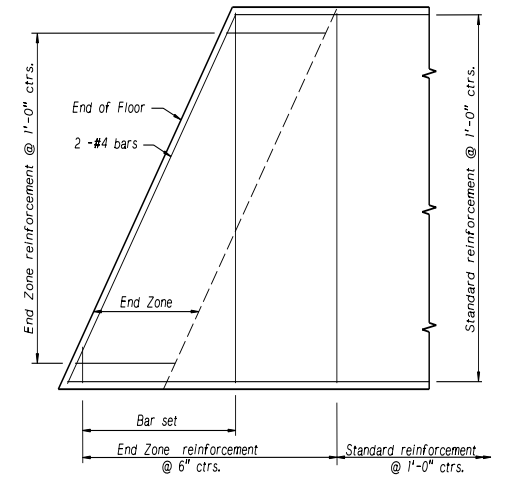
Longitudinal Bars

Longitudinal bar layouts should begin 3" from the edge of slab. The top bars will be #4 at 12" centers. The bottom bars will be #5 bars at 12" centers with the first space being 6". This will stagger the top and bottom longitudinal bar layout.

Additional reinforcement shall be provided in the top of the slab on structures continuous over the piers.

Skewed Decks

Additional end zone reinforcement will not be required in the deck at the turndown or integral abutments. In other situations where the skew requirements of AASHTO LRFD, Section 9.7.2.5 applies, the additional reinforcement in the deck end zones is required; it will be provided in the Plans as shown in the Layout Sketch. Structures wider than 44 ft. may consider more precise bar layouts.



End Zone reinforcement layout for skews greater than 25°

(Typical top and bottom)

Phased Decks

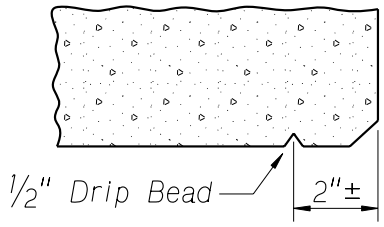
Bridge decks to be built under phasing shall meet the empirical deck cantilever requirements for the overhang provided in the first phase of construction

Cantilever Design Criteria

Future surfacing shall not be included in cantilever dead load. The effective depth shall not be reduced for a wearing surface.

Drip Bead

A drip bead must be placed on all bridge decks and concrete slab bridges. The cell shown at right, AC=DRIPBE, is available in the CAD library.

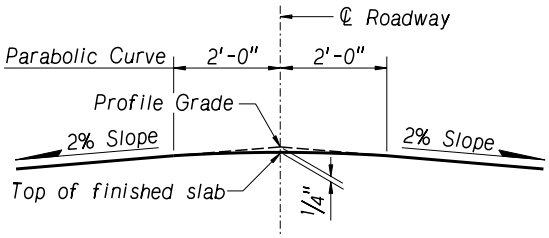


DRIP BEAD DETAIL

AC=DRIPBE

Roadway Crown

Crown of the bridge deck must be shown on all Plans, preferably on a Roadway cross section sheet. The cell shown, AC=CROWN, is available for a standard 2% crown.



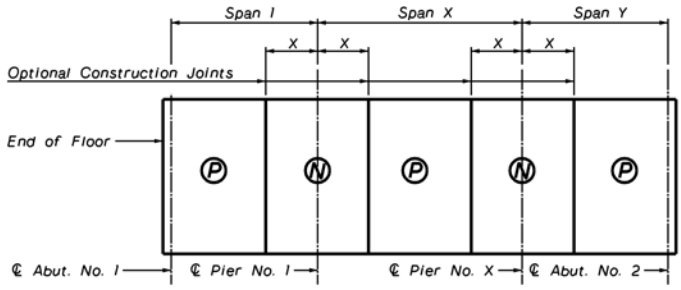
CROWN TEMPLET

Pouring Sequence

Optional transverse construction joints will be shown on the plans for placement of concrete slabs and bridge decks. The location of these transverse joints will be near the dead load moment point of counter-flexure of the supporting member. A pour may be terminated only at the completion of a positive moment area. The optional transverse construction joints must be parallel to the supports. On bridges over 49 ft. wide, optional longitudinal construction joints should be provided.

Pouring Diagram

A pouring diagram and note, as shown below, should be placed on the Front Sheet of the Plans. The note is available as the cell, AC=POUR. Continuous bridges with spans more than 175 ft. may require a special concrete placing sequence.



POURING DIAGRAM

POURING SEQUENCE:

The entire slab shall be poured starting at one end and proceeding to the other end, stopping at the completion of any "P" section.

(P)=Positive moment section

(N)=Negative moment section

Payment

All concrete provided for the rail, median, deck, diaphragms, and light bases shall be included in the pay item Class 47BD-4000 Concrete for Bridges.

All reinforcing steel provided for the rail, median, deck, and diaphragms shall be included in the pay item Epoxy Coated Reinforcing Steel.

301.02 – Girder Shims

The purpose of this policy is to establish criteria for processing of girder shims for all steel and prestressed girder bridges.

For longer bridges, the slab may be placed in sections so that the new pour is placed on the noncomposite girders while the previously poured sections became composite and may have the forms attached. To reduce these variances, especially in long-span steel bridges, designers must provide standard note #018 on the front sheet so that contractors can submit their pouring sequence before computing shim dimensions.

Standard Forms

All forms required for girder shims, including deflections and Forms One and Two of the shim's program, should be filled out completely except the items "H.I. Elevation" and "Rod Reading" on Form 2. The individual who completes the forms will then enter the data into the USHIM program and check that the elevations match those shown on the plans. The originals of these forms will be placed in the calculation's file and two copies sent to the Project Manager.

Data Transfer

The file "***** shims" will be sent to the project manager's computer terminal so that the field personnel can enter the rod readings and H.I. elevation. The project manager will be informed by phone that the file has been sent electronically and the hard copies are being mailed to them. In order for field personnel to transmit girder shim information to the Bridge Division in an effective manner, the following information will be included on the first sheet of the "Girder Shims" form. Include the DOR number, Assistant Bridge Engineer's name and phone number. This can be accomplished by placing a "sticky" in the upper left corner of the first sheet.

Example: To transmit by terminal (USHIM)
send to DORXXXX
Call U.R. Trustworthy at 479-XXXX

Deflections

Deflections for shims will be computed based on the dead loads due to slab, rail or barrier and median. This dead load will be applied equally to all girders. The deflections will be calculated at the span tenth points. A deflection or shim table will be included on the plans.

Shim Shots

Standard Note #017 must be shown on the front sheet and the following guidelines should be used for establishing the points at which rod readings are taken:

Straight Continuous Steel Girders	For all girders, give "X" distances along the top flange centerline at 10 feet intervals and at the centerline of all supports.
Cantilever Steel Girders	Give "X" distances at 10 feet intervals, at the centerline of hinges and supports.

Shim Shots *(continued)*

Curved Continuous Steel Girders	A program called "CROSHIM" is available on the IBM terminals to handle most of these kinds of structures. See the program write-up for instructions on filling out Form 1 and Form 2.
Prestressed AASHTO I Beams	For all girders, give "X" distances along the top flange centerline at 10 feet intervals and at the end of top flange at supports.
Prestressed NU Girders	For all girders, give "X" distances along the outside edges of the top flange at 10 feet intervals and at the end of top flange at supports.
Prestressed Twin Tee Girders	Give "X" distances along the outside edge of the exterior girders and along the joints between girders at 10 feet intervals, and at the end of the flange at supports.
Prestressed Inverted Tee Girders	A maximum of 6' between the lines of shots will be required. One line of shots on each exterior girder and the girder *(or two girders)* at the centerline of the roadway also will be required. Along top of the stem centerline, give "X" distances at 10 feet intervals and at the centerline of bearing at supports.

301.03 – Sidewalk Policy

General Design Criteria

Sidewalks must meet the requirements set forth in the *Americans with Disabilities Act (ADA).*

Sidewalk Width

Sidewalks on the bridge shall be constructed 2 feet wider than the approaching sidewalk to accommodate handle bars for bicycle traffic, therefore, the following criteria shall apply:

- The minimum clear width shall be 7 feet where there are sidewalks on both sides of the bridge.
- The minimum clear width shall be 10 feet where there is a sidewalk on one side of the bridge.

Approach Slabs

Bridge designers need to check with the roadway designer to ascertain specific information intended for the sidewalk. These limitations aside, the following guidelines apply to the sidewalk next to the approach slabs.

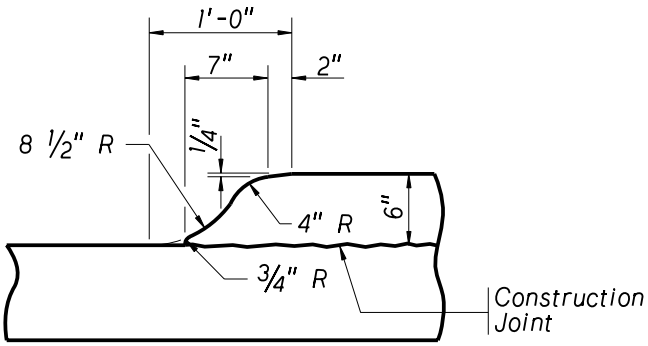
1. In all cases, the grade beam and approach section layout should extend to the outside limits of the sidewalk. This allows for placement of pedestrian protection to embankment grade elevations.
2. Designers should consider extending expansion devices to the outside edge of the sidewalk for significant movements. This provides a smoother ride for wheelchairs and bicycles. When expansion devices are extended, the bridge sidewalk should be provided into the paving section a minimum of 5 feet by extending the paving section to the outside of the sidewalk. This provides a smooth transition from the bridge structure to the sidewalk.
3. If surfacing is provided at guardrail posts, it should be asphalt. The guardrail systems require wooden post deflections to meet safety performance standards.

Concrete Rail

All concrete rail on the bridge and approach sections must be closed to prevent icing of the sidewalk.

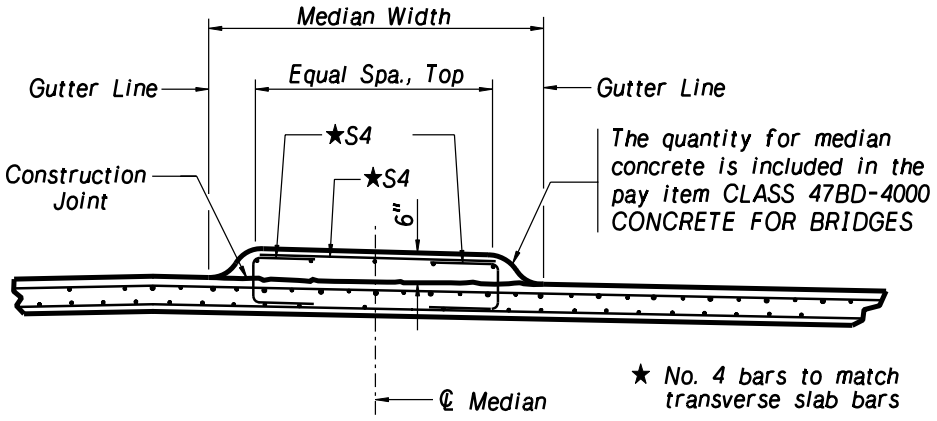
301.04 – Roadway Median and Curb Policy

Median and curb layouts should be obtained from the Roadway Designer.



CURB DETAIL

AC = CURB1



MEDIAN SECTION

AC = CURB2

301.05 – Floor Drain Policy

General Criteria

When closed rail or concrete barrier are specified for a bridge, designers will submit plan dimensions of the bridge deck and roadway drainage information to the Hydrology Section to determine if floor drains are required.

Floor drain designs will specify that the vertical structural tubing *(drop tubes)* extend at least 1 in. below the bottom flange of the girder or concrete slab bridge. In locations where runoff is not allowed to free fall, drainage systems shall be specified to carry the water to grade. Cleanouts will be provided in the design of the drainage system for all straight sections of pipe. Examples of such locations would be near parking lots, traffic or Railroads.

The point of discharge from the drains shall be evaluated to determine erosion potential. Designers should take appropriate steps to avoid erosion problems at all floor drains. Curbed edges on slope protection or splash blocks should be used to control water flow.

Coatings

All prestressed girder and slab bridges will have galvanized floor drains. All steel girder bridges will have painted floor drains in accordance with the NDOR Standard Specifications.

Reference File

There is a reference file (FLDRAN.DGN) available for detailing. The reference levels contain the following detailing options:

Level 50 = Galvanized steel
Level 51 = Painted steel
Level 52 = Standard floor drain
Level 53 = Offset drop tube

Payment

NDOR Standard Specifications state that floor drains will be paid for by the Each using the pay item, Floor Drains. Drainage systems, which includes the floor drains, will be paid for by the Each at specific locations using the pay item, Drainage System at Station _____.

301.06 – Expansion Device Policy

General

- Horizontal Movement due to thermal effects *(TM)* for expansion joint(s) shall be calculated in accordance to the Temperature Movement Policy in Chapter 2.
- Strip Seals and Deck Joint Seals shall be used in bridge decks; also, Precompressed Polyurethane Foam *(PPF)* can be used when joint width is less than two inches.
- Typical joint details for the joint systems are shown on the approach slab base sheets *(see Chapter 6).*

Approach Slab Expansion Devices

The following types of expansion devices shall be specified by the bridge designer based on the Temperature Movement *(TM)* required at the approach slab.

Preformed Joint Filler

Preformed joint filler joints may be specified for TM $\leq$ 1/2”*.*

Precompressed Polyurethane Foam Joint (PPF)

Precompressed Polyurethane Foam joints may be specified for TM $\leq$ 3” and shall meet the requirements of Precompressed Polyurethane Foam Joint Special Provision. PPF joints will consist of a 2” open gap between the approach section and paving section and PPF joint material installed by the contractor. No adjustments for temperature will be made in the construction of the gap. The pay item for this joint system will be Precompressed Polyurethane Foam Joint LF*.*

Strip Seal

Strip seals may be specified for 3” $\leq$ TM $\leq$ 4”*;* and shall meet the requirements of Section 730, “Strip Seals” in the 1997 English Units Edition of the Standard Specifications. Blockouts must be provided for installation. All installations must call for a 50 °F. median temperature with a ¼” gap variation for every ___ Y °F. All strip seals will be paid for by using the pay item, Strip Seal LF*.*

Movement Rating (MR) for Bridge Deck Expansion Devices

Installation and design of the expansion device(s) in bridge deck will be based on the Movement Rating (MR), where

MR = TM + 1”	For steel structures
MR = TM + 1 3/4”	For concrete structures

Deck Joint Seals

Deck Joint Seals may be specified for TM greater than 4”*.* All Deck Joint Seals will be the Maurer type joints and meet the requirements of Section 729, “Deck Joint Seals” in the 1997 English units Edition of the Standard Specifications. All Maurer joints will be paid for by using the pay item, Deck Joint Seal, Type IV LF*.* The following two manufacturers of Maurer joints must be shown in the Plans.

1. D. S. Brown – Maurer Series, with appropriate size number
2. Wabo-Maurer Series, with appropriate “D” size number

301.07 – Class I, II, and III Deck Repair and Overlay Policy

General Criteria

- High density low slump concrete shall not be used on any bridge overlays.
- Only Silica Fume concrete shall be used for all overlay projects.

Layout

Designers should use caution to ensure new grade profiles provide the 2" minimum overlay *(to the scarified depth)* at all points in the cross section of the roadway.

Bridges to be widened with an overlay and have new approach slabs should provide the standard 2'-5" rail height on the bridge. The approach slabs should be placed at the overlay grade and use a 2'-3" rail which requires a 5" transition to the standard buttress.

Measurement

The following definitions for measurement shall be applied to bridge repairs.

Pay Item	Definitions
Class I Repair	The area sq. yds. of the existing bridge deck that is to have a 1/2" scarification or repair for overlay.
Class II Repair	20% of Class I repair sq. yds. in lieu of more accurate information.
Class III Repair	5 sq. yds. in lieu of Deck information.

Payment

Silica Fume Overlay

Concrete for Overlay – SF cu. yds.

Class I Repair – SF sq. yds.

Class II Repair – SF sq. yds.

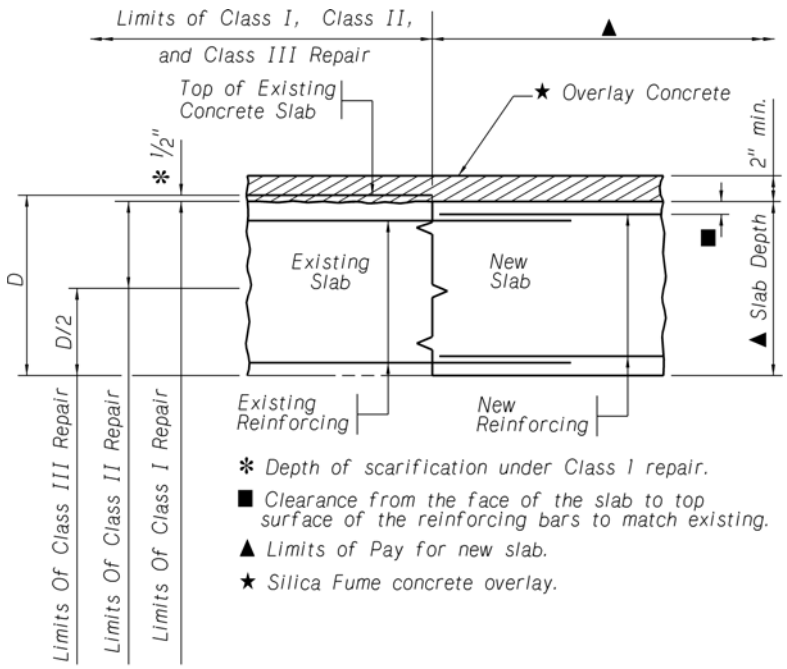
Class III Repair – SF sq. yds.

Placing, Finishing, and Curing Concrete Overlay – SF sq. yds.

Details

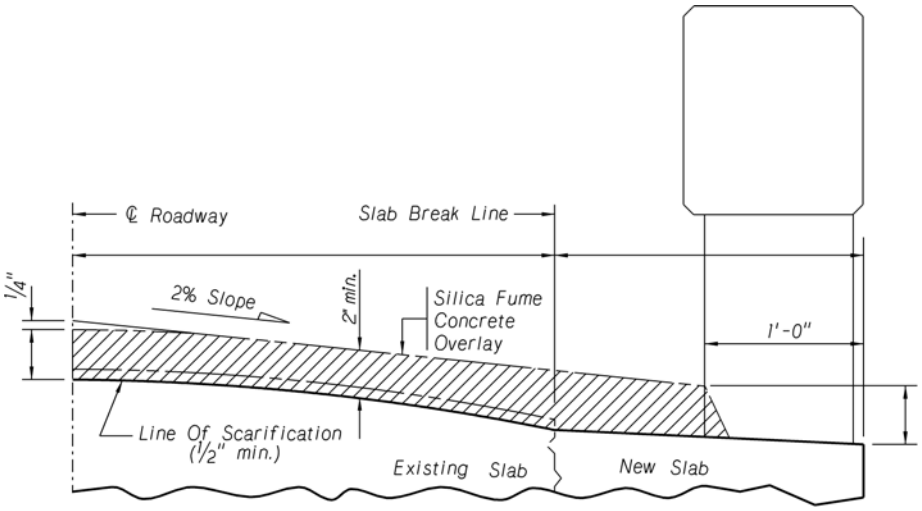
The details on the following page are available as CAD cells CONCOL and ORLAY, and shall be included in the plans for bridge repairs.

Repair and Overlay Details



SLAB REPAIR AND OVERLAY

AC=CONCOL



OVERLAY DETAIL

AC=ORLAY

SECTION 302: Concrete Slab Bridges

302.01 – Concrete Slab Bridge Policy

Slab Design Criteria

- A future surface load must be included in the bridge dead loads; see Bridge Loading Policy.
- The effective design depth will be reduced by 1/2" for a wearing surface.
- New slab bridge designs will use an f'c = 4000 psi; fy steel = 60 ksi.
- Concrete slab spans will not exceed 50 ft. unless approved by the Bridge Engineer.

Concrete Slab Base Sheet

The Concrete Slab base sheets *(see Chapter 6)* provides typical reinforcement layouts for zero, ≤30° and >30° skewed bridges. Transverse distribution steel will be placed parallel to the CL of the supports for skews up to 30°. For skews greater than 30°, the transverse distribution steel will be placed perpendicular to the CL of roadway in the following manner:

- Transverse top and bottom reinforcement will require bar sets only at the End of Floor. Additional longitudinal steel in the bottom layer *(#4 bars @ 24" centers)* will extend through the haunch to allow the transverse steel in the bottom layer to be placed continuously over the haunch without bar sets at the piers.

The base sheets are to be coordinated with the Slab Bridge Design Table. The table provides the reinforcement and length at designated locations on the base sheet *(J2 thru J11).* Designers must replace the designations shown on the base sheet *(J2 thru J11)* with standard bar marks and the following haunch information must be included on the Plans.

- For Bridge Lengths of 40 ft. to 90 ft.

  Haunch Depth = 6"
  Haunch Length = 4'-0"

  Place five *(5)* S501 bars @ the face of each haunch.

Location	Mark	No.	Length	Type	A	B	C	D	E
J10		Varies	14'-0"	106	6'	2'	9"	9"	6'
Haunch	S404	8	14'-0"	STR					

- For Bridge Lengths of 90 ft. to 140 ft.

  Haunch Depth = 9"
  Haunch Length = 6'-0"
  Place seven *(7)* S501 bars @ the face of each haunch.

Location	Mark	No.	Length	Type	A	B	C	D	E
J10		Varies	18'-0"	106	8'	2'	1'	1'	8'
Haunch	S404	8	18'-0"	STR					

Slab Bridge Design Table

Design Criteria

Bridge Length		Span No. 1 & No. 3	Span No. 2	Slab Thick-ness "T"	"X"	DL Reaction Kips/ft. of width		LL Reaction (Kips per lane) No impact		Haunch J10 (long.)
feet	mm					Abutment	Bent	Abutment	Bent	Bar
40	12190	12'-0"	16'-0"	9½"	5'-0"	0.62	3.12	40.00	45.35	6
45	13715	13'-6"	18'-0"	10"	5'-0"	0.74	3.56	40.00	49.76	6
50	15240	15'-0"	20'-0"	10½"	5'-5"	0.86	4.02	41.51	54.35	6
55	16765	16'-6"	22'-0"	11"	5'-10"	0.99	4.52	43.63	59.63	6
60	18290	18'-0"	24'-0"	11½"	6'-3"	1.08	4.89	45.45	63.85	6
65	19810	19'-6"	26'-0"	11½"	6'-8"	1.22	5.41	47.04	67.35	6
70	21335	21'-0"	28'-0"	12"	7'-1"	1.42	4.93	48.84	70.24	6
75	22860	22'-6"	30'-0"	12½"	7'-6"	1.53	6.55	50.55	72.55	6
80	24385	24'-0"	32'-0"	13"	7'-11"	1.64	6.96	52.14	74.50	6
85	25910	25'-6"	34'-0"	13½"	8'-3"	1.86	7.78	53.61	76.19	6
90	27430	27'-0"	36'-0"	14"	8'-8"	2.04	8.91	54.94	77.57	6
95	28955	28'-6"	38'-0"	14½"	9'-6"	2.15	9.69	55.67	79.70	6
100	30480	30'-0"	40'-0"	15"	10'-0"	2.41	10.39	57.15	80.64	7
105	32005	31'-6"	42'-0"	15½"	10'-4"	2.54	11.73	58.49	81.51	7
110	33530	33'-0"	44'-0"	16"	11'-0"	2.74	11.87	59.70	82.28	7
115	35050	34'-6"	46'-0"	16½"	11'-4"	2.97	12.69	60.80	82.96	7
120	36565	36'-0"	48'-0"	17"	11'-9"	3.19	13.50	61.89	83.50	7
125	38100	37'-6"	50'-0"	17½"	12'-2"	3.42	14.30	62.93	83.91	7
**130	39625	39'-0"	52'-0"	18"	12'-6"	3.65	15.18	63.89	84.375	7
**135	41150	40'-6"	54'-0"	19"	12'-10"	3.98	16.44	64.80	84.79	7
**140	42670	42'-0"	56'-0"	19½"	13'-2"	4.23	17.34	65.65	85.16	7

Edge Beam

Bar Size	Span 1 & 3	Span 2	NEG
	J8 bars	J9 bars	J11 bars
	Length	Length	Length
6	10'-8"	11'-9"	36'-0"
7	12'-0"	13'-0"	40'-0"
7	13'-10"	15'-0"	42'-0"
7	15'-0"	19'-0"	45'-8"
7	16'-6"	19'-3"	50'-0"
8	17'-9"	21'-8"	28'-0"
8	18'-10"	22'-0"	27'-3"
8	19'-10"	23'-0"	29'-3"
8	22'-8"	25'-0"	31'-3"
8	23'-3"	27'-6"	33'-0"
8	25'-0"	28'-0"	35'-8"
8	25'-0"	28'-0"	37'-11"
9	27'-3"	29'-10"	40'-6"
9	28'-0"	32'-2"	41'-9"
9	29'-0"	32'-6"	42'-6"
9	31'-0"	34'-0"	44'-7"
9	31'-3"	38'-0"	44'-9"
9	31'-6"	39'-0"	46'-3"
9	33'-9"	41'-0"	45'-4"
9	35'-3"	42'-6"	44'-4"
9	36'-10"	44'-0"	45'-0"

Slab Bridge Design Table

Top of Slab – Negative Steel

Bridge Length	@ Piers								Span 1&3	Span 2
	Longitudinal		J5 Bars			J4 Bars			S510	S405
	Bar	Spacing	Length	L1	L3	Length	L2	L4	Length	Length
40'	7	12"	11'-8"	5'-10"	5'-10"	19'-0"	10'-0"	9'-0"	5'-7"	0
45'	7	12"	13'-0"	6'-6"	6'-6"	21'-0"	11'-0"	10'-0"	6'-1"	0
50'	7	12"	15'-3"	7'-3"	8'-0"	22'-0"	11'-0"	11'-0"	7'-7"	0
55'	7	12"	17'-0"	8'-6"	8'-6"	23'-10"	11'-10"	12'-0"	8'-3"	0
60'	7	11"	17'-2"	8'-8"	8'-6"	26'-0"	13'-0"	13'-0"	8'-7"	0
65'	7	11"	17'-6"	9'-0"	8'-6"	28'-0"	14'-0"	14'-0"	9'-1"	0
70'	7	11"	18'-8"	9'-10"	8'-10"	27'-3"	14'-9"	12'-6"	9'-10"	8'-8"
75'	7	11"	19'-7"	10'-9"	8'-10"	29'-3"	15'-9"	13'-6"	10'-4"	8'-8"
80'	7	10"	20'-0"	11'-0"	9'-0"	31'-3"	16'-10"	14'-5"	10'-9"	8'-10"
85'	7	10"	21'-6"	11'-8"	9'-10"	33'-0"	17'-6"	15'-6"	11'-7"	8'-8"
90'	7	10"	24'-9"	13'-3"	11'-6"	35'-8"	19'-0"	16'-8"	11'-7"	8'-4"
95'	7	10"	26'-6"	14'-0"	12'-6"	37'-11"	20'-0"	17'-11"	12'-1"	7'-10"
100'	8	12"	27'-0"	14'-0"	13'-0"	40'-0"	21'-0"	19'-0"	12'-7"	7'-8"
105'	8	12"	28'-2"	14'-6"	13'-8"	41'-9"	21'-9"	20'-0"	13'-4"	7'-8"
110'	8	12"	29'-8"	15'-2"	14'-6"	42'-6"	22'-0"	20'-6"	14'-7"	8'-8"
115'	8	11"	29'-0"	15'-0"	14'-3"	44'-7"	23'-10"	20'-9"	14'-3"	10'-4"
120'	8	11"	29'-7"	15'-5"	14'-2"	44'-9"	24'-0"	20'-9"	15'-7"	12'-2"
125'	8	10"	29'-8"	15'-5"	14'-3"	46'-3"	25'-0"	21'-3"	16'-1"	13'-2"
**130'	9	10"	28'-10"	14'-6"	14'-4"	45'-4"	24'-4"	21'-0"	18'-3"	15'-8"
**135'	9	10"	27'-9"	14'-6"	13'-3"	44'-4"	22'-10"	21'-6"	21'-3"	16'-8"
**140'	9	10"	28'-4"	15'-0"	13'-4"	45'-0"	23'-3"	21'-9"	22'-4"	18'-2"

Bottom of Slab – Positive Steel

			Span 1 & 3		Span 2	
	Longitudinal Bars		J3 Bars	J2 Bars	J6 Bars	J7 Bars
	Bar	Spacing	Length	Length	Length	Length
40'	6	10"	10'-8"	10'-8"	11'-9"	11'-9"
45'	7	12"	12'-0"	12'-0"	13'-0"	13'-0"
50'	7	12"	13'-10"	13'-10"	15'-0"	14'-2"
55'	7	11"	15'-0"	15'-0"	19'-0"	14'-3"
60'	7	11"	16'-6"	16'-6"	19'-3"	15'-1"
65'	8	12"	17'-9"	16'-0"	21'-8"	15'-8"
70'	8	12"	18'-10"	16'-6"	22'-0"	17'-5"
75'	8	12"	19'-10"	18'-6"	23'-0"	18'-8"
80'	8	11"	22'-8"	19'-6"	25'-0"	19'-6"
85'	8	10"	23'-3"	20'-5"	27'-6"	20'-4"
90'	8	10"	25'-0"	21'-6"	28'-0"	21'-6"
95'	8	10"	25'-0"	22'-10"	28'-0"	21'-8"
100'	9	12"	27'-3"	23'-6"	29'-10"	22'-9"
105'	9	12"	28'-0"	24'-9"	32'-2"	24'-2"
110'	9	11"	29'-0"	25'-10"	32'-6"	24'-9"
115'	9	11"	31'-0"	27'-0"	34'-0"	26'-6"
120'	9	11"	31'-3"	28'-8"	38'-0"	28'-8"
125'	9	11"	32'-6"	29'-10"	39'-0"	29'-0"
**130'	9	10"	33'-9"	30'-6"	41'-0"	31'-0"
**135'	9	10"	35'-3	31'-2"	42'-6"	31'-0"
**140'	9	10"	36'-10"	32'-3"	44'-0"	32'-7"

Slab Bridge Design Table

The Slab Bridge Design Table, published in this policy may be used to provide steel reinforcement for the bridge lengths and spans specified. The following criteria was assumed for use in the mainframe program SLABDES which was used to develop the slab design table:

- **HS25 Live Load.** Designer note: The SLABDES program used for in-house designs calculates support reactions based on the specified truck loading and will not increase the LL based on the wheel distribution factors. Therefore, the program output for LL must be increased by 1.25 to provide HS25 LL reactions.
- Wheel distribution: E = (4+.06 S), where S is the span distance from CL support to CL support.
- Development lengths calculated for epoxy coated reinforcing steel.
- Design clear Roadway width = 44'-0".
- DLs: Open concrete rail = 270 plf x 2/44; Future surface = 20 psf.
- Top cover = 2.5", Bottom cover of 1", Wearing surface = 1/2"
- f'c = 3500 psi; fy steel = 60 ksi.
- Haunch Depth: 6" @ abutments; 6" @ bents for bridge lengths less than 90'; 9" @ bents for bridge lengths greater than 90'. The haunch slope is 1:8.
- J4 bars are continuous through Span 2 for bridge lengths 40' thru 60'.

SECTION 303: Prestressed Concrete Girders

303.01 – General Prestressed Girder Policy

Materials

The following material criteria shall apply to all prestressed girder bridges.

Concrete

Designers shall minimize both release and 28-day strength to meet the maximum allowable stresses. Designers shall not exceed the 28-day concrete strength of 8000 psi without the Assistant Bridge Engineer approval.

Strands

- Two types of prestressing strands shall be used by the Bridge Division as follows:

  NU Girders
  Use 0.6 in., 7-wire uncoated low-relaxation strands *(area = 0.217 in^2)*

  Inverted Tee and Double Tee Girders
  Use 0.5 in., 7- wire uncoated low-relaxation strands *(area = 0.153 in^2)*

- Strands shall conform to the requirements of ASTM A416/A416M, Grade 270.
- Strands in the end regions of the girders may be debonded to control excessive stresses due to prestressing force.

Non-prestressed Reinforcement

All non-prestressed reinforcement shall **not** be epoxy coated. Steel bars shall conform to the requirements of ASTM A615, Grade 60. Welded wire fabric shall conform to the requirements of ASTM A497. Designers shall use Fy = 60 Ksi for welded wire fabric design.

Debonded Strands

Debonded strands shall be specified by the designer in accordance to AASHTO LRFD, Section 5.11.4.2. For prestressed I girders with straight strands only, additional U-shaped bars *(G501)* shall be added to girder ends to reduce the stresses due to lifting and handling of girders *(see base sheet 6.4.3).*

Shear Reinforcement

Vertical web shear reinforcement shall be welded wire fabric as shown on the prestressed girder base sheets. Anchorage zone reinforcement shall be the maximum reinforcement of that required by shear design or the area required to resist at least 4% of the total prestressing force and placed within d/4 of the end of the girder.

Negative Moment Reinforcing Steel in Slab Over Piers

Negative moment reinforcement shall be provided in the bridge deck taking into account deck longitudinal distribution reinforcement, by assuming 100% Live Load continuity at supports. Negative moment reinforcement shall be terminated in accordance with AASHTO.

Stay-in-Place Forms

Stay-in-Place metal forms are allowed, designers shall apply to the girders an average load of 5.00 psf due to forms weight.

Camber

Camber is defined as the net result of upward deflection due to prestressing and downward deflection due to all dead loads. Camber and any correction for grade vertical curvature must be considered when determining girder seat elevations and concrete quantities. Bridge plans should indicate typical vertical dimensions from the top of the girder flange to grade at supports.

Dead Load Deflections

All girder bridge plans shall have deflections calculated at the span tenth points and labeled, “Deflections for Shims”. Deflections for shims may assume a parabolic deflection curve and use the following factors to generate deflections.

10^{th} pt deflection = (max. deflection) x Factor

Span 10^{th} Pt	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
	.00	.36	.64	.84	.96	1.0	.96	.84	.64	.36	.00

Deflections for shims table in prestressed girder base sheet shall include deflection due to dead loads only *(excluding future wearing surface).*

Standard Notes

Standard Note #331 must be included on the front sheet of the Bridge Plans. This note restricts the construction sequence of the superstructure based on the age of the girder.

Payment

All prestress superstructure bridges will use the pay item, Precast/Prestressed Concrete Superstructure at Station _____ *(Lump Sum).* This item includes payment for reinforcing steel, prestressing tendons, and Class 47BP or 47B-PHE concrete.

FLEXURAL DESIGN OF PRESTRESSED CONCRETE BRIDGES POLICY

1. **Design at Prestress Transfer:**

   a. The primary method of analysis for member capacity at prestress release shall be the strength design method, as described in the final report by the University of Nebraska-Lincoln to NDOR, dated June, 2002, titled, “Compression Limits in Prestressed Concrete Members,” and the January/February 2001 PCI Journal paper titled, “Strength Design of Pretensioned Flexural Concrete Members at Prestress Transfer,” by Noppakunwijai, Tadros, Ma and Mast. The load factor applied to initial prestress shall be 1.15. The load factor applied to bending moments due to member weight shall be 1.15 if the moment is negative, e.g. at lifting points at time of lifting, and 0.85 if the moment is positive, e.g. at midspan and at transfer length point immediately at time of prestress transfer. The initial prestress just before release may be assumed 75% of the ultimate tensile strength for fully tensioned low relaxation strands.

   b. The required concrete compressive strength obtained from the analysis according to Section 1a shall not be taken than a minimum of 4500 psi, *(to maintain a minimum quality of concrete and acceptable bond with up to 0.6 in. diameter strands).*

   c. The incremental stress in the reinforcing steel caused by the combined factor axial load and bending moment due to prestress and self weight defined total stress from analysis according to Section 1a less initial prestress just before release, shall not exceed a tensile stress of 60 ksi. Alternatively, the top bonded tensile steel stress, according to a cracked section analysis for combined unfactored prestress plus member weight, shall not exceed 30 ksi.

   d. The top steel, stress at factored load levels using the analysis of Section 1a, shall not exceed the yield point of the steel grade used.

   e. Calculation of the required amount of top bonded tensile reinforcement on the basis of uncracked section analysis is no longer permitted.

2. **Design at Service:**

   a. The primary method of analysis for member capacity at service shall be the strength design method, as described inn the final report by the University of Nebraska-Lincoln to NDOR, dated June, 2002, titled “Compression Limits in Prestressed Concrete Members,” and the November/December 2002 PCI Journal paper titled, “Elimination of Prestressed Concrete Compression Limits at Service Load,” by Noppakunwijai, Al-Omaishi, Tadros, and Krause.

b. Flexural strength shall be calculated using the strain compatibility procedure as described in Section 8.2.2.5 of the PCI Bridge Design Manual. Strength checks must include all loading combinations and the cross section to which they apply. For cases for which no significant live load exists, LRFD Strength IV with a dead load factor of 1.5, rather than Strength I, may be the critical case.

c. For service load limit state analysis, limiting concrete compressive stress due to effective prestress plus dead load to $0.45f'_c$ is not required. Similarly, limiting concrete compressive stress due to effective prestress plus full loads to $0.60\ f'_c$ is not required.

d. For service load limit state analysis, concrete compressive stress due to 50% of effective prestress, 50% of dead load, plus 100% of live load shall be limited to $0.4f'_c$.

e. For service load limit state analysis, concrete tensile stress due to the loading combination given for Service III conditions, shall be limited to $6\sqrt{f'_c}$.

f. Final deflection due to effective prestress plus dead loads shall be an upward camber. No sagging is permitted.

g. Live load deflection shall be limited to Span/800.

h. Maximum debonded length of strand shall be limited to Span/10.

303.02 – Prestressed I Shaped Girder Policy

General Design

The Nebraska University *(NU)* prestressed girder sections shall be used for all new prestressed I-shaped girder designs. The exception to this would be for bridge widenings where matching the type of the new girder(s) to the existing girders may be desirable. The use of AASHTO Sections require permission of the Bridge Engineer.

NU Sections

The NU prestressed girder sections and properties are listed below.

Girder	Height in.	Web Width in	Top Flange in.	Bottom Flange in.	Area in^2	Yb in.	Inertia in^4	Weight Lbs/Ft
NU 900	35.4	5.9	48.2	38.4	64B.1	16.1	110,262	680
NU 1100	43.3	5.9	48.2	38.4	694.6	19.6	182,279	724
NU 1350	53.1	5.9	48.2	38.4	752.7	24.0	302,334	785
NU 1600	63.0	5.9	48.2	38.4	810.8	28.4	458,482	840
NU 1800	70.9	5.9	48.2	38.4	857.3	32.0	611,328	894
NU 2000	78.7	5.9	48.2	38.4	903.8	35.7	790,592	942

Composite Design

To allow for the loss of the wearing surface, the design slab thickness shall be 1/2” less than the actual bridge slab thickness when calculating the composite section in the positive moment regions. Composite properties and superimposed dead loads without any future wearing surface load, as shown on the prestressed girder base sheet, must be included in all Plans. The midspan composite section properties refer to the gross concrete area, including the effective transformed concrete area of the slab, but does not include the prestress strand or the slab reinforcement.

Girder Spacing

The maximum girder spacing for prestressed girders shall be 12’.

Bearing Design

Bearings designed for prestressed girders will use temperature ranges as stated in the Temperature Movement Policy and will include a calculated creep movement from 7 days to infinity *(see Section 305.03).*

Strands

The maximum number of strands for the NU bottom flange is 58 strands. Four additional top strands shall be tensioned to 2 kips/strand and shall not be accounted for in the design.

Strand Drape

The strand hold-down points shall normally be located at 0.4 and 0.6 points of the prestressed girder. However, quarter and third points are also acceptable. Consideration should be given to using only straight parallel strands on short prestressed girders < 50’ due to the high hold-down force required.

NU Girder Haunch

One inch minimum haunch at CL girder between the bottom of the bridge deck and top of girder at midspan is required. The 1” haunch is a construction tolerance and must be used to calculate girder seat elevations only, and not used for calculation of composite section properties.

Diaphragms

Intermediate diaphragms shall not be required on prestressed girder bridges except for the following:

- Tests or structural analysis indicate they would be required.

During construction, the lateral stability of the girders is critical, therefore; standard note #332 must be included on the front sheet of the Bridge Plans. This note is a reminder that the contractor is responsible for construction loading and conditions while the bridge is being built.

Diaphragms at the piers *(or bents)* shall require a mandatory construction joint at a point 2/3 of the girder height measured from the bottom of the girder. End diaphragms *(slab turndowns)* at abutments shall require a mandatory construction joint at bottom of the slab elevation.

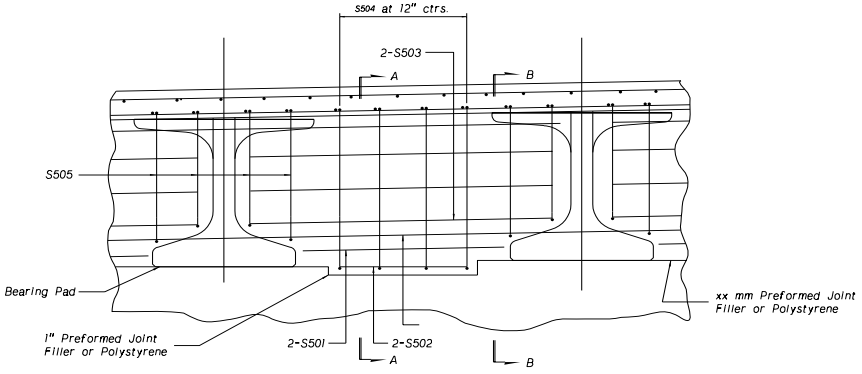
Details for pier/bent diaphragm and slab turndown at abutment are shown on Pages 108 and 109 and can be used as detail guidelines. Details shown on Pages 108 and 109 are the minimum reinforcement, designers should calculate the required reinforcement on a case-by-case basis.

Payment

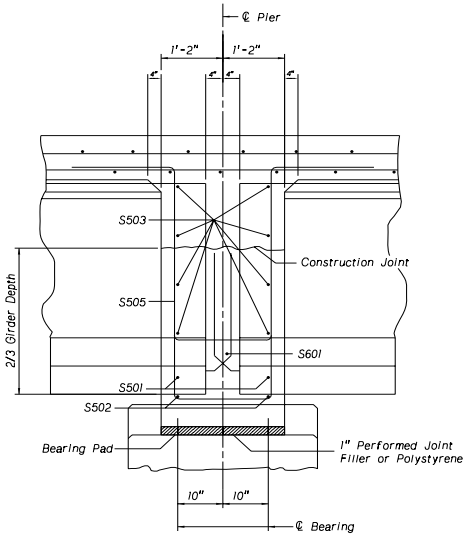
When intermediate diaphragms are specified for the NU girders, the pay item, Steel Diaphragms *(Each),* must be shown on the Plans. This item includes payment for furnishing and placement of the steel diaphragms.

Bridge Base Sheets

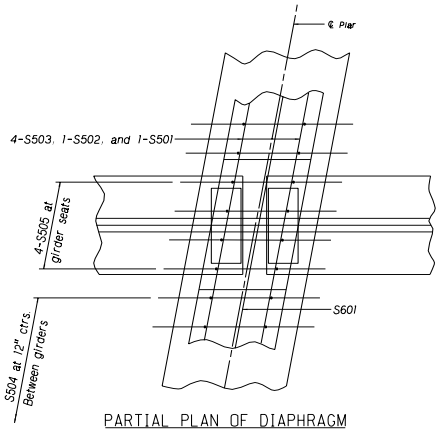
There is a base sheet reference file, see Chapter 6 for the NU girder sections. Designers must use the base sheet unless geometry or engineering judgment requires a change in the prestressed girder detailing.



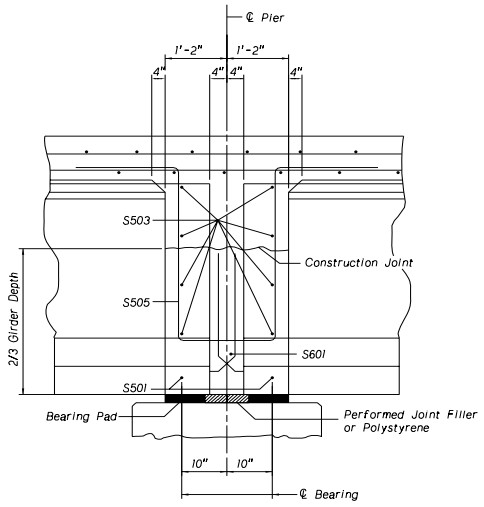
TYPICAL SECTION NEAR DIAPHRAGM



SECTION A-A



PARTIAL PLAN OF DIAPHRAGM



SECTION B-B

PIER (BENT) DIAPHRAGM DETAILS

303.03 – Prestressed Double Tee Girder Policy

General

No construction tolerance between the top of the girder and bottom of the 5-inch cast-in-place deck at midspan is recommended for Double Tee girders.

Double Tee Bearing Design

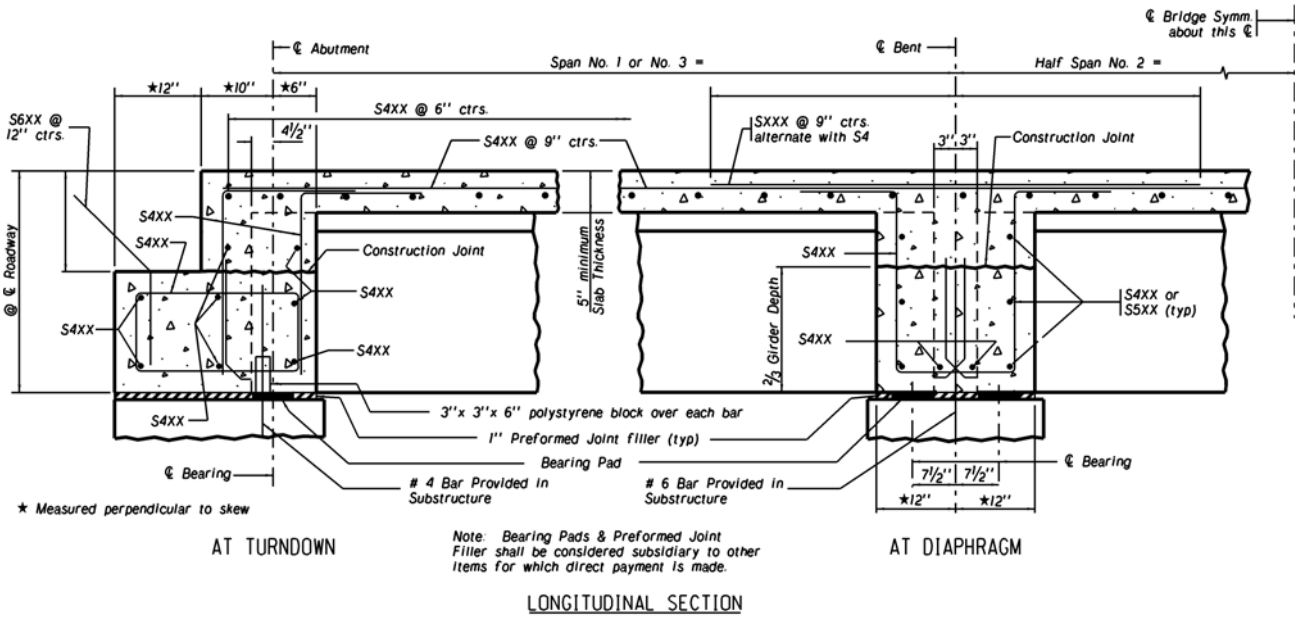
Elastomeric bearing thickness will be designed for double tee girders. Payment will be considered subsidiary to the item Precast/Prestressed Concrete Superstructure at Sta. _____. Designers must provide a note in the Plans *(similar to standard note #632)* that specifies payment.

If designers prefer movement between the superstructure and the substructure, polystyrene blockouts may be used in the diaphragms. Blockouts should be around the vertical rebar that extends from the support into the diaphragm. Blockouts should be shown in the end diaphragm details.

Turndowns and End Diaphragms

The cell (AC=TTSEC) is available to provide the standard detailing for the diaphragms at the supports. The detailed Plan information is not complete and designers will have to complete the detail or it cannot be used in the Plans.

If a blockout is used around the vertical rebar *(see Double Tee Bearing Design),* this design should be indicated in this detail as shown below.



AC=TTSEC

Double Tee Strands

Strand placement must be symmetrical about the centerline of the beam section. 24.5-inch deep beams can have up to 20 strand per beam; 10 strand maximum per stem. 32.5-inch deep beams can have up to 24-strand per beam; 12-strand maximum per stem.

At the beam ends, the first row of strand must be placed 5 in. from the bottom. All other spaces must be designed using a multiple of 2 in. and must be shown on the Plans.

At midspan, the first row of strand must be placed at least 3” from the bottom and shown on the Plans.

At midspan, the first row of strand must be placed at least 3” from the bottom and shown on the Plans. Normally, all other spaces are designed using 1/2 in. and indicated on the Plans.

Cast-in-place slab shall have concrete compressive strength of 4000 psi and minimum thickness of 5 in. Slab reinforcement is a single layer of #4 bars at mid thickness*. Transverse bars shall be spaced at 6 in. centers. Longitudinal bars shall be spaced at 9 in. centers.

To accommodate railing loads at overhang, additional #5 bars shall be spaced at 6 in. to alternate with the transverse reinforcement and extended 2’-0” beyond CL of girder stem.

Bridge Base Sheets

There are two base sheets available for the 24.5” and 32.5” double Tee section *(see Chapter 6).*

303.04 – Prestressed Inverted Tee Girder

General Design

The Nebraska University Inverted Tee *(IT)* prestressed girder sections can be used for short to medium span bridges with depth limitations and to replace deficient concrete slab bridges.

IT Sections

The most commonly used IT prestressed girder sections and properties are listed below.

- depth are based on the actual geometry and include the notch:

Girder	Height (in)	Web Width (in)	Flange Thickness (in)	Flange Width (in)	Area (in^2)	Centroid * (in)	Inertia (In^4)	Weight (Lbs/ft)
IT 300	13.31	6.31	5.50	23.63	178.40	4.49	2,019	186
IT 400	17.25	6.31	5.50	23.63	203.27	5.77	4,437	212
IT 500	21.19	6.31	5.50	23.63	228.11	7.19	8,274	238
IT 600	25.13	6.31	5.50	23.63	252.96	8.73	13,773	264
IT 700	29.06	6.31	5.50	23.63	277.81	10.34	21,154	289
IT 800	33.00	6.31	5.50	23.63	302.66	12.01	30,629	315
IT 900	36.93	6.31	5.50	23.63	327.52	13.72	42,403	341

* Measured from the bottom of the girder

Composite Design

To allow for the loss of the wearing surface, the design slab thickness shall be 0.5 in. less than the actual bridge slab thickness when calculating the composite section in the positive moment regions. Composite properties and superimposed dead loads without any future wearing surface load, as shown on the prestressed girder base sheet must be included in all Plans. The midspan composite section properties refer to the gross concrete area including the effective transformed concrete area of the slab, but does not include the prestress strand or the slab reinforcement.

Girder Spacing

The maximum girder spacing for the Inverted Tee prestressed girders shall be 28.75 in.

Distribution of Loads

Based on research done by the University of Nebraska, a distribution factor of S/5.5 shall apply to the Inverted Tee system.

Bridge Deck

Cast-in-place slab thickness is 6 in. Slab reinforcement is a single layer of reinforcement at mid thickness. Slab concrete compressive strength is 4000 psi.

Bearing Design

Two layers of SBS Modified Base Sheet may be used as bearing material under inverted tee girders. The base sheet must cover the entire abutment or pier cap. If the grade profile at the support is greater than 1%, elastomeric pad bearings shall be used. Designers shall use Elastomeric Bearing Design Policy 3.5.4 for bearing pad design.

Strands

The maximum number of strands for the Inverted Tee bottom flange is 22 strands. Two additional top strands shall be tensioned to 2 kips/strand and shall not be accounted for in the design. All strands have straight profile.

Intermediate Diaphragms

Intermediate diaphragms are required for the Inverted Tee girder bridges. A minimum of one diaphragm at mid span or two diaphragms at the third points are required. Payment for the concrete diaphragms will be subsidiary to the pay item “Class 47BD-4000 Concrete for Bridges”.

Diaphragms at the piers *(or bents)* shall require a mandatory construction joint at a point 2/3 of the girder height measured from the bottom of the girder.

Bridge Base Sheet

There is a base sheet reference file for the Inverted Tee sections in Chapter 6.

303.05 – Post-Tensioned I Shaped Girder Policy

General Design Criteria

- The Nebraska University *(NU)* post-tensioned girder sections shall be used for all new post-tensioned I shaped girder designs.

NU Sections

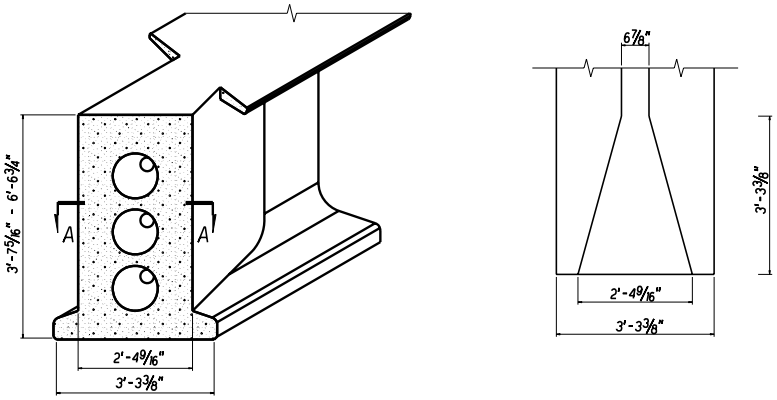
The NU post-tensioned girder sections and properties are listed below.

Girder	Height (in.)	Web Width in.	Top Flange in.	Bottom Flange in.^{2}	Area in.^{2}	Yb in.	Inertia in^4	Weight Lbs./ft
NU 1100P	43.3	6.9	49.2	39.4	737.2	19.7	189,116	769
NU 1350P	53.1	6.9	49.2	39.4	805.0	24.1	314,986	839
NU 1600P	63.0	6.9	49.2	39.4	872.8	28.6	479,529	910
NU 1800P	70.9	6.9	49.2	39.4	927.1	32.3	641,264	966
NU 2000P	78.7	6.9	49.2	39.4	981.32	36.0	831,604	1023

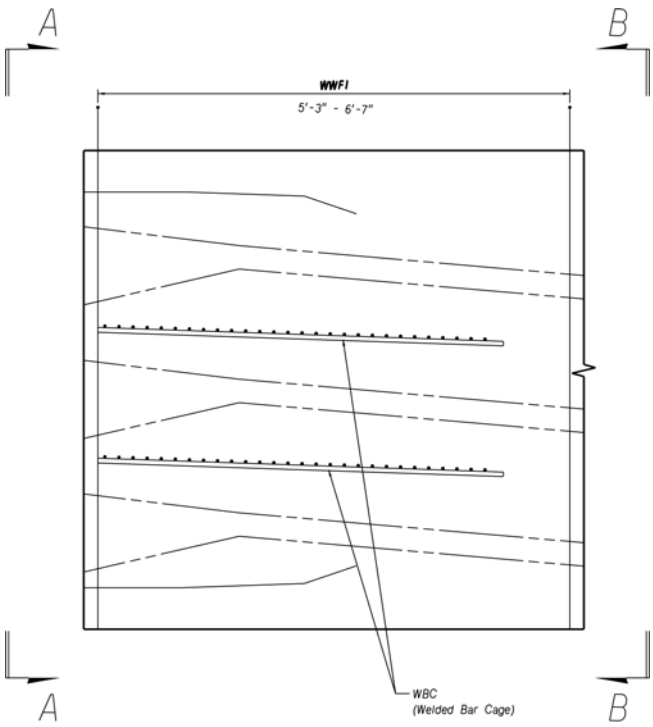
- The maximum girder spacing for post-tensioned girders shall be 12'.
- Typically, the maximum number of pre-tensioned *(prestressed)* strands in the bottom flange is 46.
- Pre-tensioned *(prestressed)* strands shall be provided to resist girder self weight and construction loads *(see prestressed girder policy).*
- The Bridge Division policy is to apply post-tensioning in one stage before casting the deck.
- All Prestressed, Post-Tensioned girders shall conform to the requirements of Section 705 of the Standard Specifications.
- Construction Sequence item under post-tensioning notes *(see base sheet)* should describe girder erection and post-tensioning procedure during construction. Designers shall determine and include the required steps on the base sheet of the bridge plans.
- Camber due to post-tensioning must be considered when calculating girder seat elevations.

Anchorage *(End)* Block

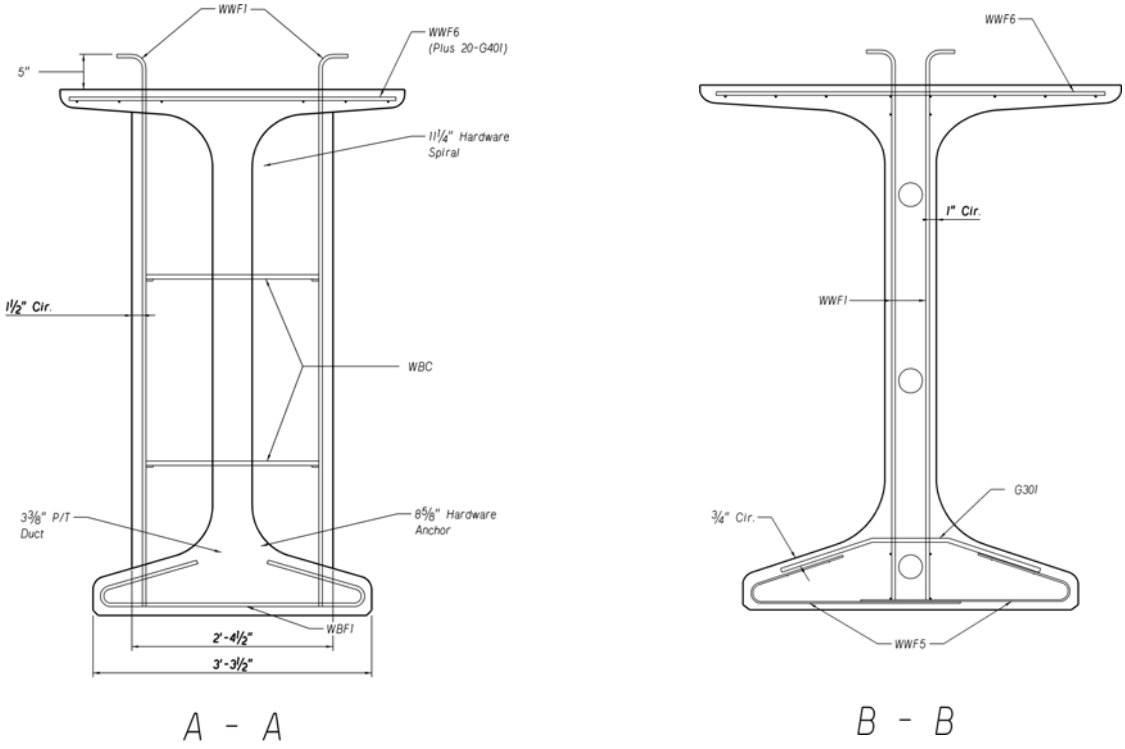
The Bridge Division policy is to use the anchorage block developed by University of Nebraska in all post-tensioned girder bridges. The Anchorage block will accommodate up to three tendons with fifteen 0.6-strand each. The standard post-tensioning anchorage zone dimensions and reinforcing details for all NU I-girder sizes are shown in the following details.



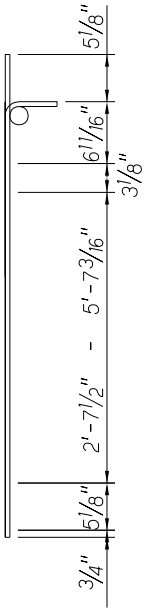
Standard NU I-Girder Post-Tensioning Anchorage Block



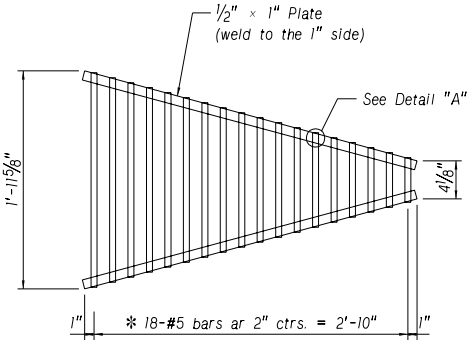
GIRDER ELEVATION



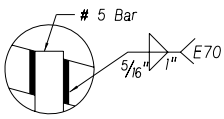
Standard Post-Tensioning Anchorage Zone Reinforcement



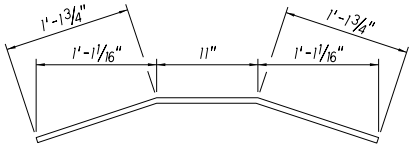
WWF1



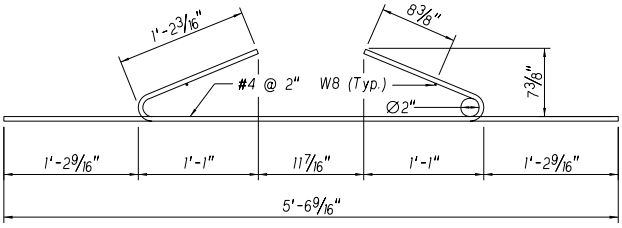
WBC



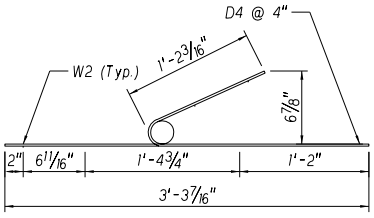
DETAIL "A"



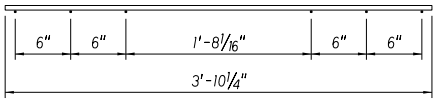
G301



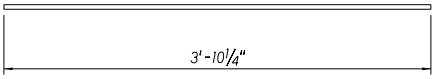
WBF1



WWF5



WWF6



G401

Standard Post-Tensioning Anchorage Zone Reinforcement

Action	Girder Size	Provided Reinforcement	
		Area (in^2)	Distance (in)
Transverse Bursting* (WWF1)	NU1100P	11.34	63.0
	NU1350P	11.34	63.0
	NU1600P	11.34	63.0
	NU1800P	12.76	70.9
	NU2000P	14.17	78.7
Top Flange Bursting in Thin Direction (WWF6)	NU1100P	6.30	63.0
	NU1350P	6.30	63.0
	NU1600P	6.30	63.0
	NU1800P	7.09	70.9
	NU2000P	7.87	78.7
Web Bursting in Thin Direction (WBC)	NU1100P	10.97	35.4
	NU1350P	10.97	35.4
	NU1600P	10.97	35.4
	NU1800P	10.97	35.4
	NU2000P	10.97	35.4
Bottom Bursting in Thin Direction (WBF1)	NU1100P	6.30	63.0
	NU1350P	6.30	63.0
	NU1600P	6.30	63.0
	NU1800P	7.09	70.9
	NU2000P	7.87	78.7
Note: Reinforcement was designed to resist post-tensioning in combination with vertical shear.			

Post-tensioning Anchorage Reinforcement for NU I-Girders

Tendons

A maximum number of three tendons can be used for the design of NU post-tensioned girders *(see Anchorage Block details).* Each tendon has a maximum of 15 - 0.6-inch diameter, low relaxation strands with ultimate strength of 270 ksi and modulus of elasticity 28,500 ksi. The tendons will be threaded through the ducts which were installed during the girder fabrication. Positions, clear spacings and minimum concrete covers for post-tensioned ducts are shown in NU post-tensioned girders base sheets *(see Chapter 6).*

Tendons Profile

The post-tensioning profile for tendons will typically have a parabolic shape, this is the most efficient tendon profile from the standpoint of steel stress loss.

NU Girder Haunch

One inch minimum haunch at CL girder between the bottom of the bridge deck and top of girder at midspan is required. The 1” haunch is a construction tolerance and must be used to calculate girder seat elevations only. It must not be used for calculation of composite section properties.

Standard Notes

Standard notes #021 and #336 must be included on the front sheet of the bridge plans.

Payment for Post-Tensioning

All Post-Tensioned superstructure bridges will be measured for payment by the lump sum using the following pay item:

"Precast-Prestressed/Post-Tensioned Concrete Superstructure at Station _____ Lump Sum (LS).

This pay item is considered full compensation for furnishing all components of the precast-prestressed/post-tensioned superstructure including the cost of prestressing, precasting, and post-tensioning.

Diaphragms

Intermediate diaphragms will not be required on post-tensioned girder bridges with up to 150 ft. spans, additional tests or structural analysis will be required for longer spans.

End diaphragms *(slab turndowns)* at abutments and diaphragms at the piers *(or bents)* shall require a mandatory construction joint at the bottom of the slab.

Lateral Stability

During construction, the lateral stability of the girders is critical, therefore, standard note #337 must be included on the front sheet of the Bridge Plans. This note is a reminder that the contractor is responsible for construction loading and conditions while the bridge is being built.

Payment for Intermediate Diaphragms

When intermediate diaphragms are specified for the NU girders, the pay item "Steel Diaphragms" must be shown on the Plans. This item includes payment for furnishing and placement of the steel diaphragms.

Bearing Design

Bearings for post-tensioned girders shall be designed according to BOPP Section 305.03, taking into account the elastic shortening due to post-tensioning.

Bridge Base Sheets

There is a base sheet reference file, see Chapter 6, for the NU Post-Tensioned girder sections. Designers must use the base sheet unless geometry, design, or engineering judgment requires a change in the Post-Tensioned girder detailing.

SECTION 304: Steel Girder Design

304.01 – General Steel Girder Design Policy

General Girder Design Criteria

- All multiple span steel girder bridges will be designed as continuous structures.
- Preliminary design of steel superstructures should investigate the following sections in this order based on cost:
  - Compact rolled sections.
  - Combination of welded plate girder for main spans and rolled sections for the short spans.
  - Welded plate girders.
  - Hybrid welded plate girders.
- If fatigue governs the design of steel beams *(using LFD method),* designer shall use HS20 live load for fatigue design only. Strength capacity will be based on HS25 live load.
- The maximum girder spacing for all steel girders shall be 12 ft.
- Bridge members that qualify as Fracture Critical Members *(FCM)* are required to be identified in the Plans as fracture critical. FCM is a component in tension whose failure is expected to result in the collapse of the bridge or the inability of the bridge to perform its function.
- Form hanger tack welding of any kind is prohibited in the NDOR Standard Specifications. Therefore, all steel girder Plans must include standard note #152 as a reminder to the Contractor.
- Contractors need to be aware of the effect of torsion on the exterior girders caused by the eccentric loading of the overhang form brackets at the time of placing the slab concrete. Therefore, standard note #012 must be included on the front sheet of the bridge plans.
- Designers shall use slab turndown details on Page 121 as guidelines.

Stay-in-Place Forms

Stay-in-Place metal forms are allowed, designers shall apply to the girders an average load of 5:00 psf due to forms weight.

Field Sections

In general, field sections for steel girders may be up to 120 ft. long and weigh up to 60 kips. Site conditions and the location of the project may reduce these maximum limits.

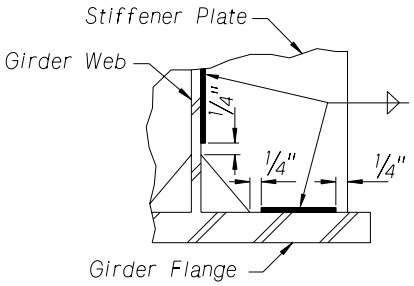
Composite Design

All steel girder bridges will be designed as composite structures.

Shear Connectors

Shear connectors shall be 7/8” diameter and meet the requirements of the current AASHTO specification. The Shear Connector Detail shown, *(AC=SHEAR1)* will be provided on all Plans.

Stud Diameter inch	Weight (Lbs) of 100 studs having in-place length of				
	3 in.	4 in.	5 in.	6 in.	7 in.
1/2	21.0	27.0	33.0	39.0	45.0
5/8	33.6	43.2	52.8	62.4	72.0
3/4	49.0	61.5	74.0	86.5	99.0
7/8	64.0	81.0	98.0	1150	132.0



TYPICAL STIFFENER WELD DETAIL

AC = SHEAR1

Positive Moment Regions

The actual bridge deck thickness will be reduced ½" for the composite design to account for the wearing surface.

Negative Moment Regions

Only the slab reinforcement will be considered to act compositely with the steel beams in calculating the resisting moments.

Charpy V-Notch

Required Testing

The following members in a steel girder bridge shall be considered as a main tensnion member and, therefore, require Charpy V-Notch testing.

1. All rolled beams used as girders or as primary stress-carrying members.
2. All flange plates of a welded plate girder in a tension zone.
3. All web plates.
4. All field splice plates.

Plan Detailing

Steel girder layouts will indicate the compression and tension zones for the purpose of Charpy V-Notch testing. The following CAD cells must be shown on the plans as required.

CHARPY IMPACT TEST REQUIREMENTS FOR MAIN TENSION MEMBERS
For the purpose of impact test the following material shall be classified as main tension members: All flange plates marked thus • All web plates All field splice plates

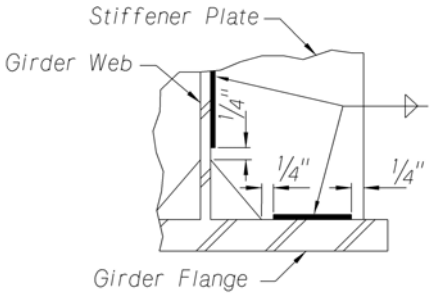
AC = CHARP1

CHARPY IMPACT TEST REQUIREMENTS FOR MAIN TENSION MEMBERS
For the purpose of impact test the following material shall be classified as main tension members: All girders All field splice plates

AC = CHARP2

Stiffener Welds

Welds must terminate 1/4" from the end of the welded plate to avoid fatigue problems at th stiffeners; see Separator Policy. The CAD cell AC=STIFWD will be placed in all steel girder Plans.

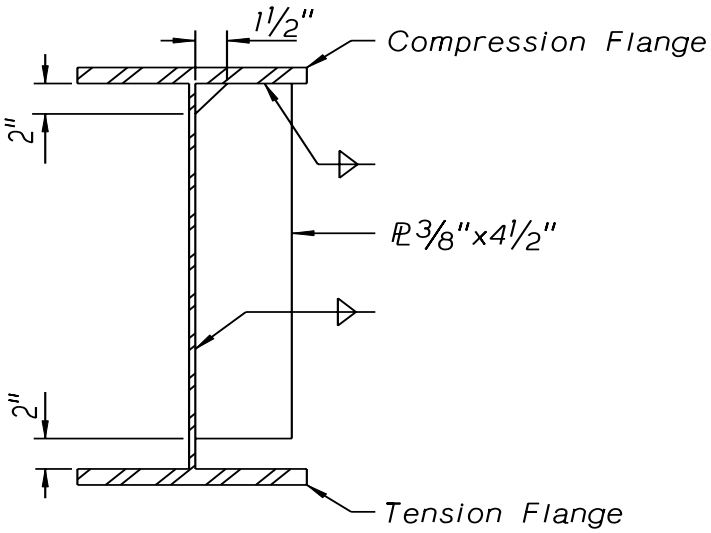


TYPICAL STIFFENER WELD DETAIL

AC = STIFWD

Intermdeiate Stiffeners

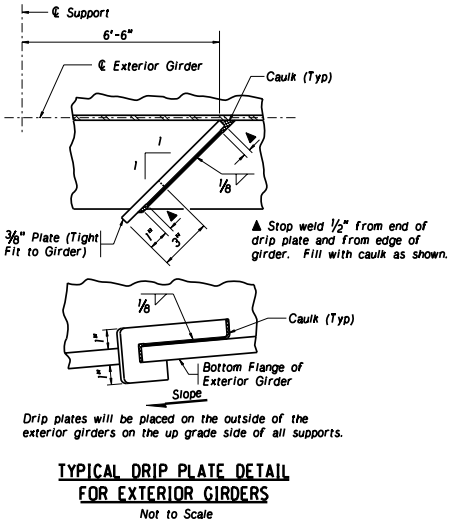
The CAD cell AC=STIFIN should be used to indicate intermediate stiffener attachment to the girder. Compression and tension flange zones must be shown on the girder sheets.



AC = STIFIN

Weathering Steel Drip Plates

The Cell AC=DRIPPL will be used to specify drip plates for all weathering steel girders. Drip plates should be 6'-6" away from the CL supports to avoid staining the pier or abutment concrete.

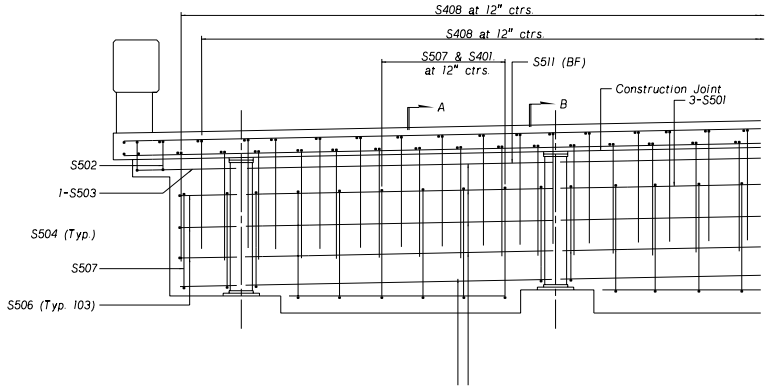


AC=DRIPPL

Payment

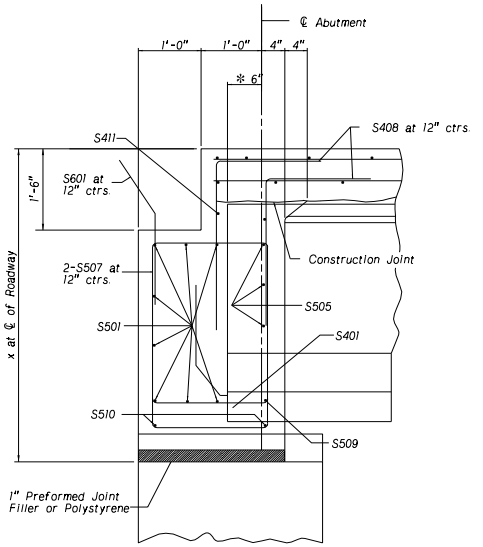
New steel for superstructures must use the standard pay item #040, Steel Superstructure at Station *(LS)*. Steel for widened or rehabilitated structures should use the standard pay item #041, Structural Steel for Superstructure *(Lbs.)*

END DIAPHRAGM (SLAB TURNDOWN) DETAILS

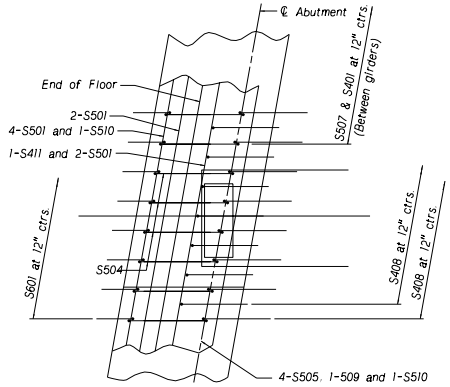


TYPICAL SECTION NEAR TURNDOWN

(FF)=Front Face
(BF)=Back Face

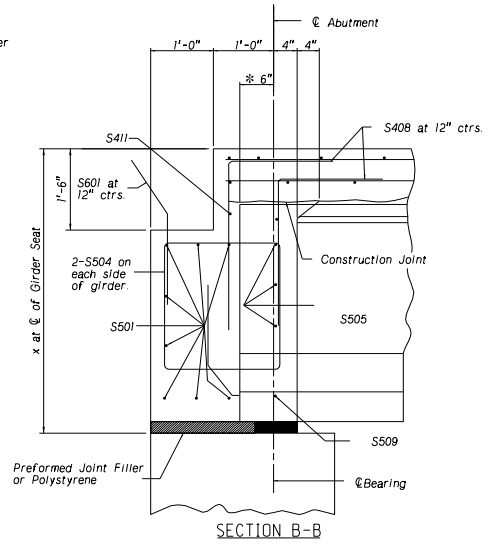


SECTION B-B



PARTIAL PLAN OF TURNDOWN

* Measured along ℄ of girder



SECTION B-B

304.02 – Field Splice Policy

General Design Criteria

- Designers should minimize the number of different splice plate thickness specified for a bridge.
- Field splice shall be located in a constant web depth area.
- Girder clear gap shall not exceed 0.375 in. and web center shall be used for alignment details *(not shown in the plans).*
- Connection bolts shall be 7/8 in. ASTM A325 *(AASHTO M164).*
- Class A surface condition shall be used for splice design.
- Web and flange bolt threads shall be excluded from the shear plane.
- For composite design, only slab reinforcement developed beyond the splice shall be used and slab thickness shall be reduced 1/2 in. for the wearing surface.
- For LFD design, designers shall use HS20 loading for live load fatigue.
- A minimum of eight bolts must be used for each half of a flange splice on all girders.
- Design slip resistance for slip-critical connections shall be 21 ksi for load factor design.

Elimination of Field Splices

Based on construction criteria and the approval of the engineer, contractors may eliminate any field splice by extending the heavier section without any change in contract price or quantities. Designers shall include standard note #137 on the front sheet of the bridge plans. Changes in the plans will be shown in the shop plans.

Detailing

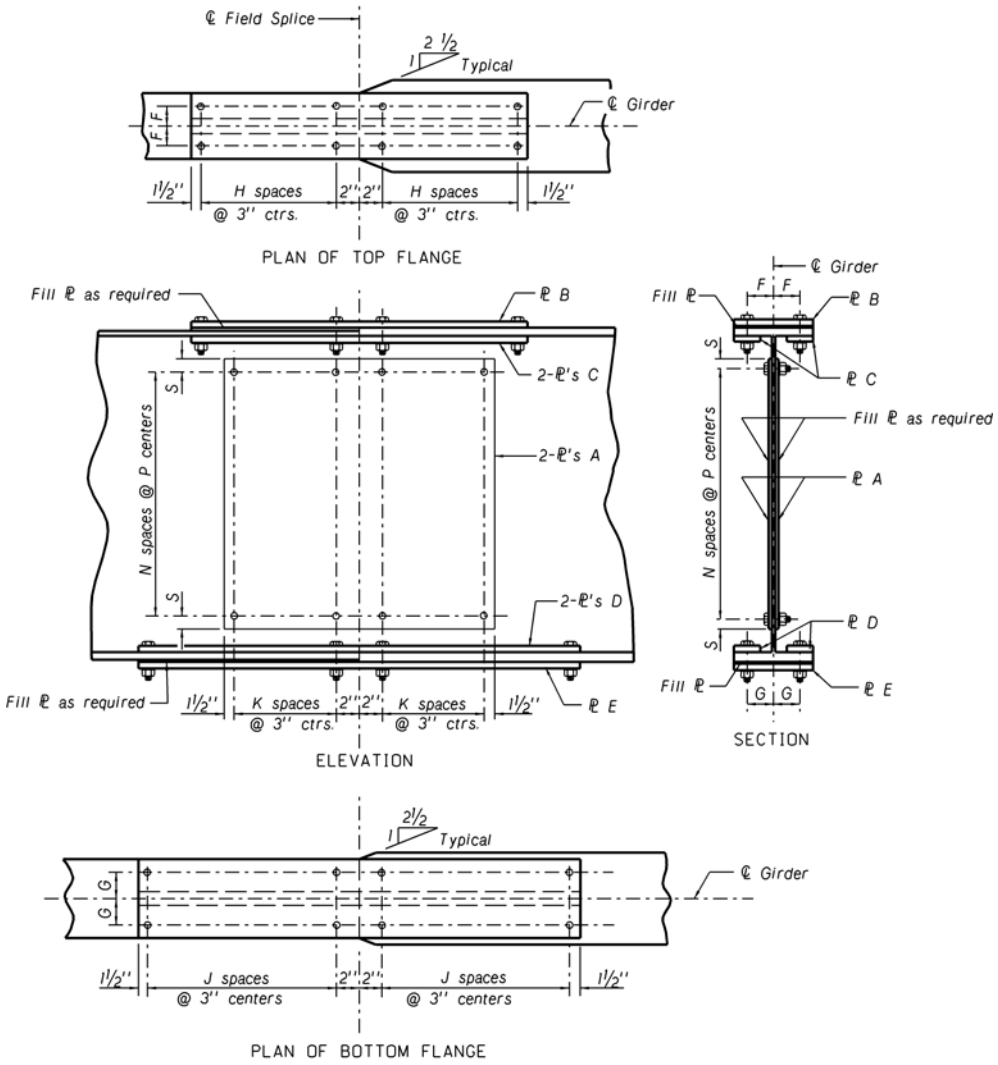
The following data tables and detail are available as CAD cells.

FIELD SPLICE DATA													
	Plate A	Plate B	Plate C	Plate D	Plate E	Number of Bolt Spaces				Bolt Spacing			
Field Splice	Thick, Width, Length	Thick, Width, Length	Thick, Width, Length	Thick, Width, Length	Thick, Width, Length	H	J	K	N	P	F	G	S

AC = FSTAB1

FIELD SPLICE DATA							
Field Splice No.							
	Thickness	Width	Length				
Plate A							
Plate B							
Plate C							
Plate D							
Plate E							
Number of Bolt Spaces				Bolt Spacing			
H	J	K	N	P	F	G	S

AC=FSTAB2



FIELD SPLICE DETAILS

AC=FS

304.03 – Bearing Stiffener Design Policy

General Design Criteria

The following definitions apply to the details in this policy.

Definitions

bf = Bottom Flange width
b = Stiffener width
b' = Net stiffener width touching bottom flange
t = Stiffener thickness
tw = Web thickness
18tw = AASHTO length of web

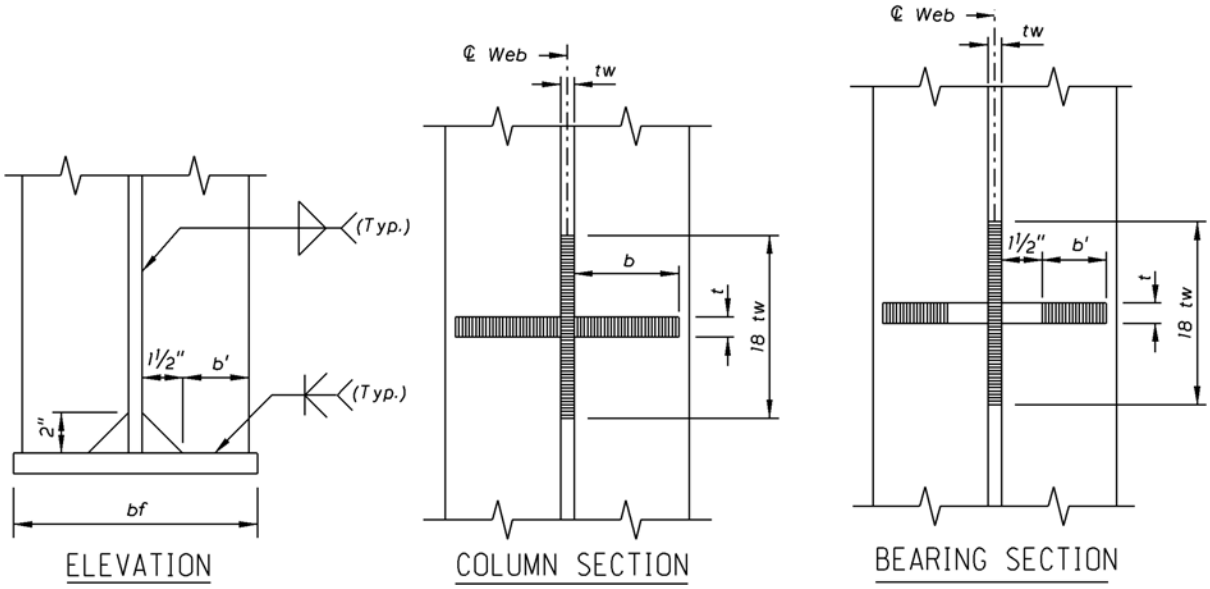
Integral Abutments

Integral abutments do not normally require bearing stiffeners because the girder ends are cast into concrete before significant shear is applied to the bearing. However, the Bridge Division will require a stiffener be placed at the centerline of bearing for anchorage. *(Use detail AC = STIFB2 shown on the following page.)*

Column Design

The following cross sectional area may be used to design bearing stiffeners as a column between flanges of a steel girder.

Column Area = 2(b*t)+18*tw^2*



Bearing Stiffener Details

General Bearing Stiffeners

The detail *(AC=STIFB1)* will be used when bearing stiffeners are required by design. Plans must indicate locations where the detail is applied to the fabrication of the girder.

Stiffeners at Bearing

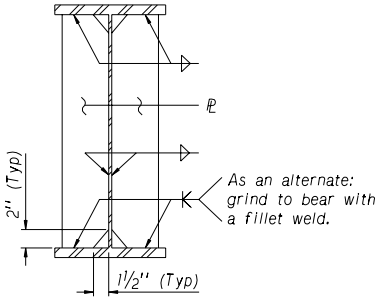
When bearing stiffeners are not required by design, the detail (AC=STIFB2) will be used for rolled beam girders and at integral abutments. A fillet weld is sufficient at these locations. The “Full Penetration” weld and “Grind to Bear” alternate are not required. Plans must indicate the locations where the detail applies to the girder.

A stiffener plate will be required at the CL of bearing for integral abutments, even though; it is not required by design. The stiffener will be used to anchor the girder, instead of acting as a bearing stiffener. Therefore, a full penetration weld will not be required.

Since rolled beams may not require bearing stiffeners, stiffener attachment at the piers for rolled girders need only meet the design criteria for the separator design. Again, a full penetration weld will not be required at these locations.

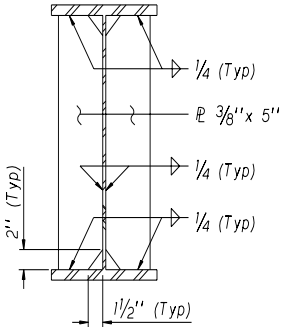
Pier Bearing Stiffeners

All pier bearing stiffeners will be perpendicular to the CL of the girder as shown in the cell below *(AC=STIFP).*



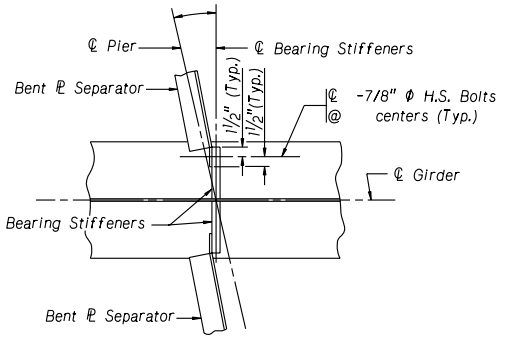
BEARING STIFFENERS
AT ABUTMENTS AND PIERS

AC = STIFB1

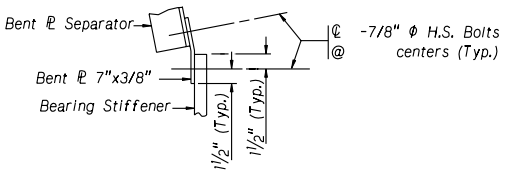


STIFFENER AT SUPPORTS

AC = STIFB2



PLAN OF BEARING STIFFENER AT PIERS



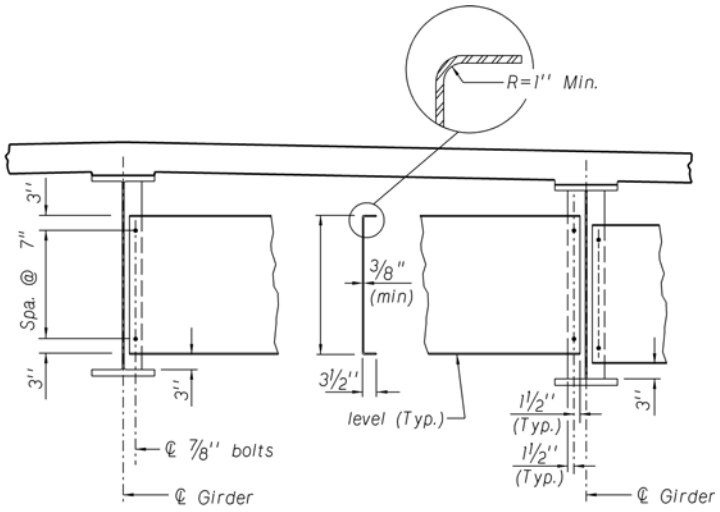
ALTERNATE SEPARATOR CONNECTION

304.04 – Steel Girder Separator Policy

General

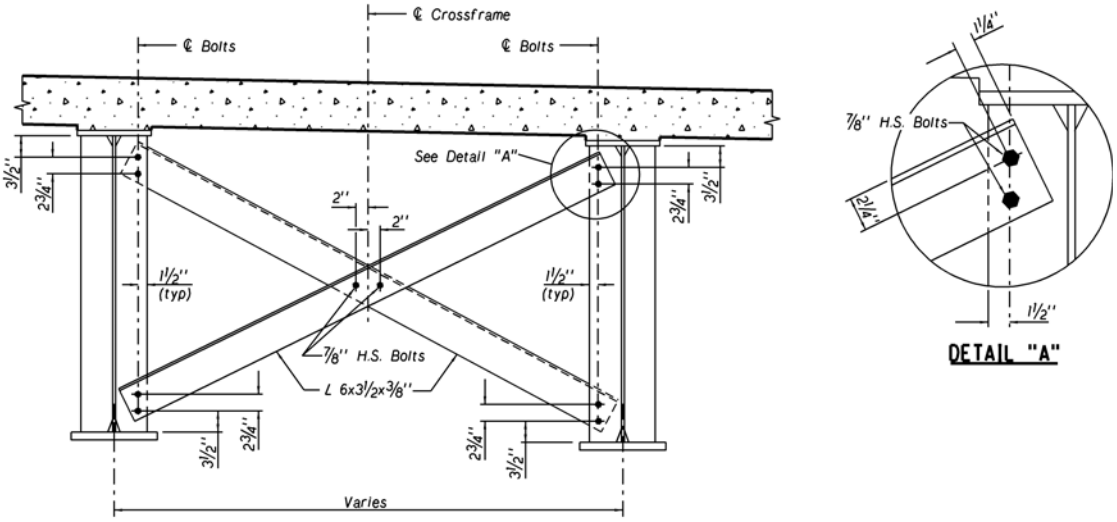
- For structures with straight alignments and skewed supports, separators shall be provided perpendicular to the CL roadway.
- Staggered layouts for skewed supports should be avoided.
- For structures on curved alignments, separators shall be provided on radial lines.
- Separators shall be “X” or “K” type cross frames or bent plate seprators “X”, “K”, and bent plate separators shall be shown on the plans as acceptable alternates when conditions allow.
- Quantities shown on the plans shall be based on separator with least weight.
- Bolt spacing for bent plate separators shall be as close as possible to the 7 in. maximum spacing.

AC=BENTPL



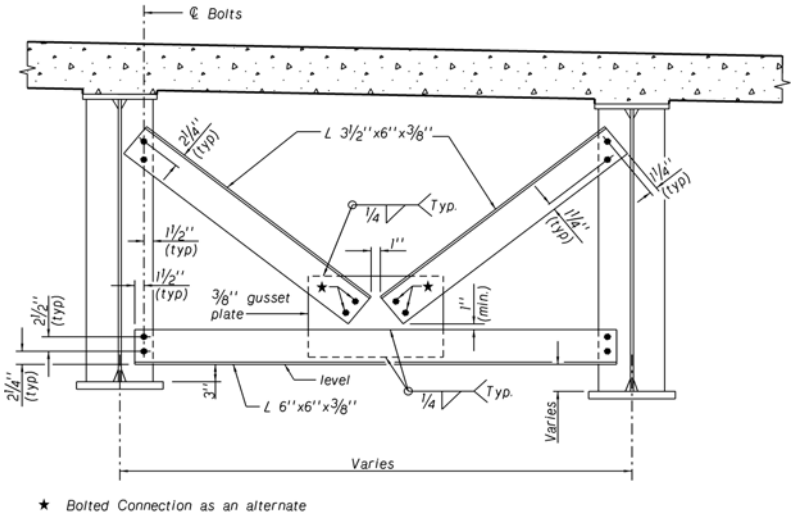
BENT PLATE SEPARATOR

AC=XFRAME



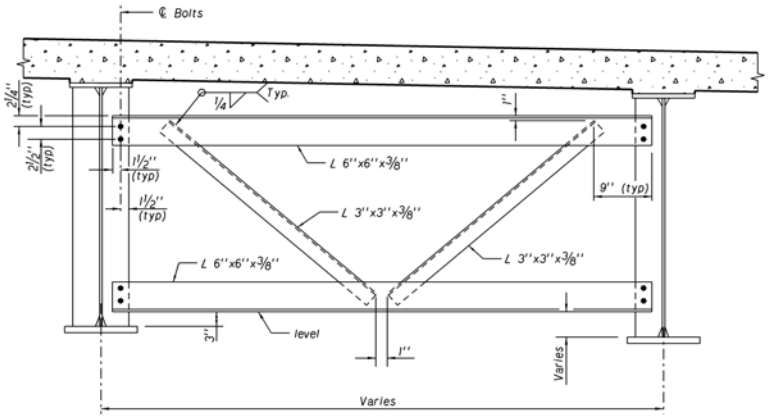
X-FRAME

DETAIL "A"



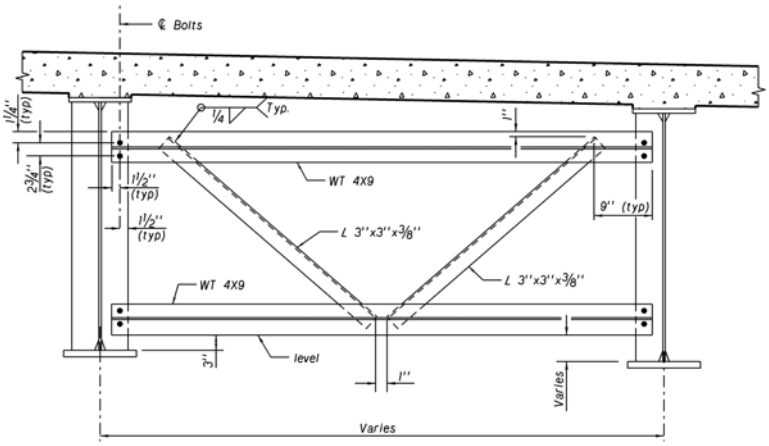
K-FRAME

AC=KFRAME



MODIFIED K-FRAME
(L 6''X6''X⅜'')

AC=MKFRMI



MODIFIED K-FRAME
(WT 4X9)

AC=MKFRM2

Design Requirements

- Minimum depth and maximum spacing for girder separators shall satisfy AASHTO 10.20.1 provision.
- Lateral stresses due to wind loads versus allowable strength in compression shall satisfy AASHTO 10.20.2.2 provision.
- Slenderness ratio *(KL/r)* for compression members shall satisfy AASHTO 10.7 provision.

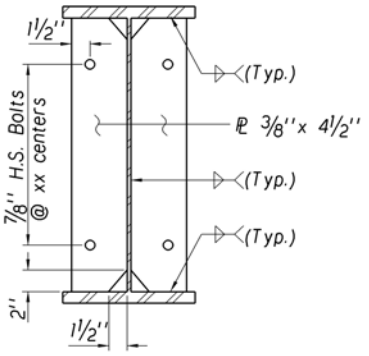
Stiffener Plates at Separators

Welded Connections

The transverse stiffener plate at separator connections should be designed to meet AASHTO category C fatigue criteria. Separator stiffeners should be welded to both the tension and compression flanges as shown below. The TYPICAL STIFFENER WELD DETAIL *(AC = STFWLD)* must be used for welded separator connections; see GENERAL STEEL GIRDER DESIGN POLICY.

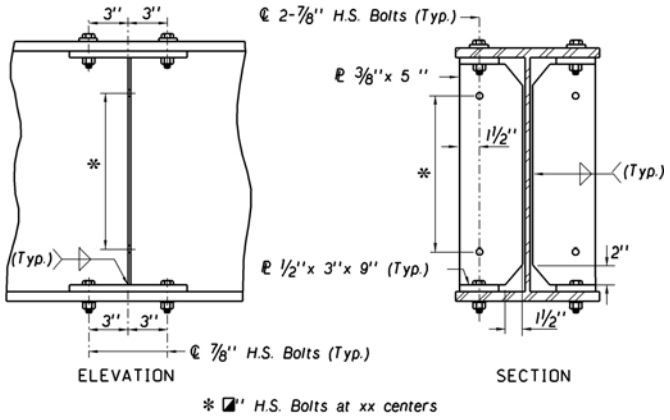
Bolted Connections

If design requires an AASHTO category B connection, designers should check the fatigue stresses at the tip of the stiffener to web weld.



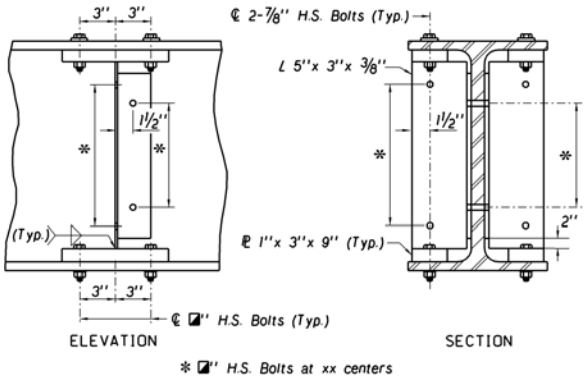
STIFFENER PLATES AT SEPARATORS
AC=STFSEP

If the fatigue stress range at the tip of the web weld is category C, then the web connection should be a weld as shown in cell STIFWD. If the fatigue stress range is category B, then the web connection should be bolted angles, as shown in cell STIFBT. Designers should note that the stiffener base plate for bolts webs is much thickner to avoid clipping the angle stiffeners.



BOLTED STIFFENER AT SEPARATORS
(BOLTED FLANGE WITH WELDED WEB)

AC=STFWLD



BOLTED STIFFENER AT SEPARATORS
(BOLTED FLANGE AND BOLTED WEB)

AC=STFBLF

304.05 – Welded Plate Girder Policy

Flange Plates

Shop welded butt splices must avoid the maximum moment regions. Splices should be specified when a reduction in flange size would represent a saving of about 800 lbs. of plate. Flange widths will be specified in 2" increments. The table at right indicates preferred flange plate width to thickness ratios. 3/4"x1'-0" is the minimum Bridge Division flange size; see the Structural Steel Policy for available plate thicknesses.

Width	Thickness
1'-0"	3/4, 7/8
1'-2"	1, 1 1/8, 1 1/4
1'-4"	1 3/8, 1 1/2, 1 5/8
1'-6"	1 3/4, 2
1'-8"	2, 2 1/4
1'-10"	2 1/4, 2 3/8
2'-0"	2 3/8, 2 1/2
2'-2"	2 1/2, 2 3/4
2'-2"	2 1/2, 2 3/4

Designers should note that there is a cost break for plates less than 1½".

The number of different flange plate widths and the number of different flange plate thicknesses used on a given bridge design should always be kept to a minimum. Designs should vary the flange thickness and minimize the flange width changes.

Web Plates

Web depths shall be specified in the Plans using 2" increments, with a 4'-0" minimum web depth. The web must have a constant depth for at least 3'-6" at the supports.

Web thickness should have an original and an alternate design. The original design shall be a stiffened web normally 1/16" or 1/8" less than the unstiffened web. The alternate design will be the unstiffened web. The standard note #231 shall be shown on the girder sheets. Webs may be designed to vary in thickness between the field splices. Under no circumstances will butt splices be allowed in areas of high shear.

Hybrid Girders

Designers shall consider the use of hybrid girder for positive moment areas, negative moment areas or the entire girder if the preliminary design of the superstructure indicate a need for using higher strength steel – HPS70W – for one or both of the flanges.

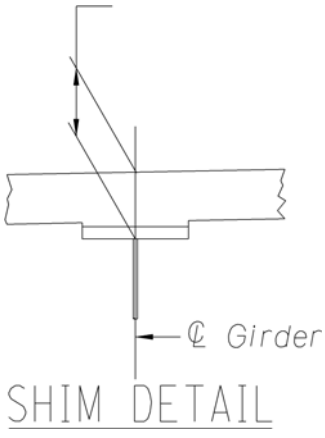
Stiffeners

Bearing stiffener designs should be in accordance with the Bearing Stiffener Policy. Longitudinal stiffener designs should generally be avoided.

The most economical transverse stiffener design, for fabrication reasons, is no stiffener plates in the low shear areas and a minimum number in the high shear areas. The minimum stiffener size shall be 3/8" x 5".

Shims

Plans must indicate the expected shim at the supports as shown in the cell AC=SHIMWB. The shim for welded plate girders is shown as the distance from the top of the web line to the finished grade. The top of web line should be established so that the thickest top flange plate is 1/2" below the bottom of the bridge deck. This provides a 1/2" construction tolerance and a minimum shim at these locations. Field splice top plates may be embedded in the deck no more than 1".



AC = SEIMWB

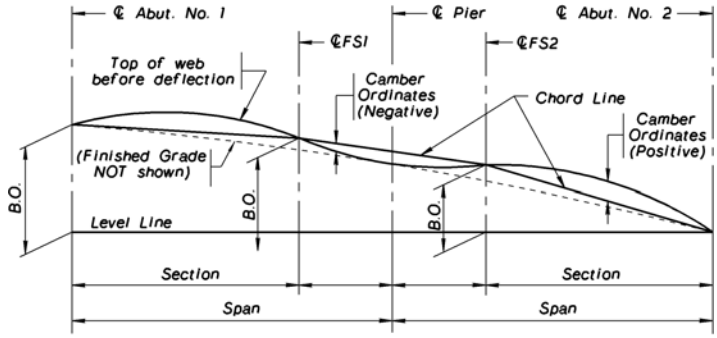
Welded Plate Girder Camber and Blocking Diagram

A Camber and Blocking Diagram must be provided on the girder sheets as outlined below.

- Blocking Ordinates *(B.O.)* establish relative positions of the superstructure from a level line. The blocking diagram must provide blocking ordinates at all end supports where the superstructure is discontinuous and at all field splices. The blocking ordinates will match the grade offsets at the field splice locations. Blocking Ordinates will be used to fabricate the girder in the shop and to assemble the sections in the field.
- Camber Ordinates *(C.O.)* are the offset distances, at span tenth points, from the required camber to a chord line drawn from end to end of a field section. Welded plate girders will be cambered to counter the total dead load deflection while sustaining the top of web line parallel to the finish grade. Future surfacing dead load deflections should not be included in the shim deflections. The computer program, KDCAMBER, is available for "in house" designs to provide Camber and Blocking Ordinates. The Deflection Ordinates output provided by KDCAMBER must not be used as the dead load deflection for shims.

Deflection, Camber & Blocking Ordinates				
Location	**Span Tenth Point**	**Camber Ordinate (in.)**	**Blocking Ordinate (in.)**	**DL Deflection for Shims (in.)**
Abutment No. 1	10	00		00

- A table(s) indicating the deflection for shims, camber ordinates, and the blocking ordinates must be shown in the Plans.



CAMBER AND BLOCKING DIAGRAM

Generally, a Camber and Blocking Diagram with a single Camber and Blocking Data Table will be adequate. However, if camber coordinates differ by more than " at a tenth point locations, or Blocking Ordinates do not vary with additional camber and blocking data for individual girders or group of girders. Examples of design criteria influencing camber and blocking ordinates would be: skew, vertical grade profile, horizontal curvature, and girders of different lengths.

Quantities

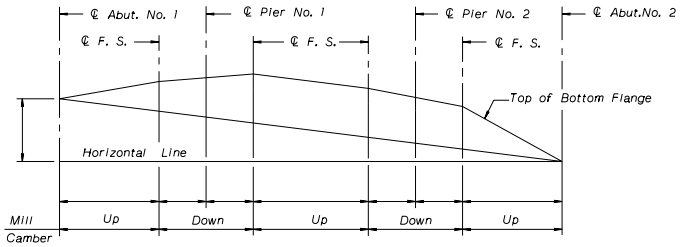
Quantities shall be based on girders with transverse stiffeners and calculated by using the Plan dimensioned volume times 490 pcf.

304.06 – Rolled Beam Girder Policy

Blocking Diagram

Rolled beams will not be cambered unless authorized by the Bridge Engineer. Therefore, camber ordinates at the span quarter points will not generally be provided on the Plans. A Blocking Diagram must be provided on the girder sheets as outlined below.

- The Blocking Diagram must provide ordinates at all end supports where the superstructure is discontinuous and at all field splices. The blocking ordinates will match the grade offsets at the field splice locations.
- The placement *(upward or downward)* of the mill camber must be specified on the Blocking Diagram. The computer program, KDCAMBER, is available for "in house" designs to check the vertical offsets between grade and a straight line between field splices. The offset will determine mill camber, shear stud length and girder seat adjustments. The Deflection Ordinates output determines stud length and girder seat adjustments. The Deflection Ordinates output provided by KDCAMBER must not be used as the dead load deflection for shims.
- Since a straight line is assumed between the blocking ordinates, the girder seat elevations at the piers *(or bents)* may need to be adjusted accordingly.
- A table(s) indicating the deflection for shims and the blocking ordinates must be shown in the Plans.



ROLLED BEAM BLOCKING DIAGRAM

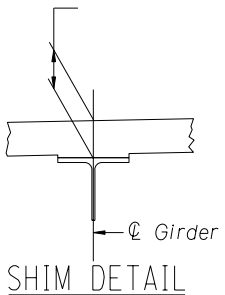
Deflection & Blocking Ordinates		
Location Span 10^{th} points	Blocking Ordinate (in.)	DL Deflection for Shims (in.)
Abut. No.	0	0
.1		xx
.2		xx
.3		xx
FS No. 1	xx	
.4		xx

Shims

Plans must indicate the expected shim at the supports as shown in the cell AC=SHIMRB. The shim for rolled beams is the distance from the top of the top flange to the finished grade. The minimum shim must provide 1/2" clear between the top flange and the bridge deck. This provides a 1/2" construction tolerance and a minimum shim at these locations. Field splice top plates may be embedded in the deck no more than 1".

Quantities

Quantities for the rolled beam shall be based on the plf provided by AISC. Other structural steel quantities for the girder shall be based on 490 pcf.



SHIM DETAIL

AC = SEIMRB

SECTION 305: Bearing Devices

305.01 – General Bearing Design Policy

Definitions

The following definitions apply to all types of bearings:

Bearing	Assembly of materials designed to transmit forces from the superstructure to substructure while facilitating translation and/or rotation.
Bearing Pad	A pad constructed partially or entirely of elastomer for the purpose of transmitting loads and facilitate movements.
Length (L)	The dimension parallel to the C.L. of the girder.
Width (W)	The dimension perpendicular to the C.L. of the girder.
Rotation (R)	A lack of parallelism between the top and bottom of the bearing.
Elastomer	Virgin natural rubber or virgin neoprene.
Translation	Horizontal movement of the bridge.
Transverse	The horizontal direction normal to the longitudinal axis of the bridge.

Bearing Pads

There are three general types of bearing pads approved for use by the Bridge Division:

1. Plain Elastomeric pad made from elastomer only.
2. Steel reinforced elastomeric pad made from steel plates vulcanized between layers of elastomer.
3. Cotton duck pad *(CDP or fabric pad)* made from layers of cotton duck and elastomer bonded together during vulcanization.

See Elastomeric Bearing and CDP Policies for more specific information.

Bearing Design Criteria

- The type of bearing to be used shall depend on vertical loads, horizontal movement and rotation requirements. *(See Bearing Selection)*
- NDOR designers may use the Excel bearing design spreadsheet Bearings *(DORDOMNT1/DORIMAGE1/BRIDGE/APPS/BEARINGS)* for the design of Elastomeric and CDP bearings.
- Tapered bearing pads or holes of any form in the bearing pad will not be allowed.

Horizontal Movements

Temperature Movement

- Temperature movement *(TM)* as defined in the Temperature Movement Policy 202.07 shall be used to calculate thermal effects.

Shrinkage and Creep of Prestressed Concrete Girders

- Shrinkage and creep shortening of pre-tensioned and post-tensioned concrete girders must be considered when designing expansion bearings.
- The following table can be used to estimate shrinkage and creep shortening for NU prestressed concrete girders.

Girder length (ft.)	50	65	82	100	115	130	150	165	180	195
Shrinkage & Creep Shortening (in.)	3/8	1/2	5/8	3/4	7/8	1	1¼	1 3/8	1 1/2	1 5/8

- For spans over 195 ft. and post-tensioned concrete girders, designers should refer to AASHTO LRFD 5.4.2.3.2 and 5.4.2.3.3 for more precise estimate.

Rotation

Longitudinal and transverse rotations are assumed to take place about the C.L. of the bearing. Generally, the most significant rotations are about the transverse bearing axis. However, if rotations about the longitudinal axis are significant, they should be included in the bearing design.

Bearing rotations may result from one or more of the following sources:

- Grade slope.
- Girder camber.
- Fabrication and construction tolerances.
- Dead load and live loads.

The calculation of live load bearing rotation is not required for bearings designed in accordance with NDOR bearing design policies, because live load rotation is accounted for in the minimum design rotation requirement.

Designers must calculate dead load rotation for each bearing. For design purposes, dead load rotation will be defined as the slope of the portion of the girder in contact with the bearing and shall be calculated as follows:

- Slope for rolled sections shall be taken as the slope of a straight line between bearing elevations.
- Slope for welded plate girders may be taken as the slope of a straight line between grade elevations approximately 12” on either side of C.L. of the bearing.
- Slope of prestressed girders shall be taken as the slope of a straight line between the bearing elevations, plus the slope of a straight line between the end of the girder and the 1st tenth point due to the net girder camber.

See “Cotton Duck”, “Elastomeric”, or “Pot” Bearing Policies for specific rotation information.

Designers should note that beveled sole plates are not required for girder slopes of less than 0.010 radians *(1% slope)*. See Sole Plate Policy.

Fixed Bearings

Fixed bearings are designed to not allow horizontal movement. They are designed only for vertical loading and rotation requirements. Anchor bolts or rebar pinning must be designed to transmit horizontal loading to the substructure. For the purpose of fixed bearing design, it will be assumed that the substructure is capable of resisting the lateral load.

Expansion Bearings

Expansion bearings are designed to accommodate translation in addition to rotation and vertical loading requirements. Plain and reinforced elastomeric bearings are designed to allow movement by utilizing their elastomeric properties. CDP bearings shall be designed for expansion by adding a low friction Polytetrafluorethylene *(PTFE)* sliding surface to the pad, which slides across a stainless steel plate attached to the sole plate.

PTFE Bearing Surface

To accommodate horizontal movement, a 3/32" thick, low friction, virgin, unfilled Polytetrafluorethylene *(PTFE)* sheet shall be bonded to the upper surface of a CDP. The Bridge Division does not allow the use of PTFE with plain or reinforced elastomeric bearings.

Anchor Bolts

- Anchor bolts shall be used with fixed and expansion bearings to securely anchor steel girders and rolled beams to piers or bents.
- Anchor bolts will not be required where turndowns and pier concrete diaphragms are being used.
- Anchor bolts for fixed and expansion bearings shall be designed to resist the larger of the horizontal design load or 10% of the maximum vertical loads.
- Number, size, and depth of embedment of anchor bolts shall conform to AASHTO 10.29.6.2 minimum requirements.
- Anchor bolts shall be designed to resist uplift as specified by AASHTO 3.17.
- Anchor bolt diameter should be specified in the plans using English bolt size.
- Swedged anchor bolts must be specified when anchor bolts are placed in existing concrete.

See Pedestal Policy for Anchor Bolts Layout.

305.02 - Bearing Selection

Cost and size are the two factors that generally govern the selection of a bridge bearing. Designers should use their engineering judgment and the following guidelines for bearing type selection:

- For fixed bearings with equivalent loads, there is little cost difference between plain cotton duck pads, plain elastomeric pads, and moderately sized reinforced elastomeric pads with a minimal number of shims. The cost increases significantly for reinforced elastomeric bearings as the size and the number of shims increases.
- For expansion bearings with movement up to 2 1/2", there is little cost difference between CDP bearings with PTFE and stainless steel sliding plates, and reinforced elastomeric bearings.
- CDPs with PTFE and stainless steel plates are generally required when horizontal movement is greater than 2 1/2", due to the Bridge Division bearing height limitation for elastomeric pads.
- Plain or reinforced elastomeric bearings are generally used for light to moderately heavy loads and moderate movement, or where area of the pad is not a design contraint, as in the case of prestressed wide flange girders.
- CDPs are used for light to very heavy loads, and can accommodate any horizontal movement when used with PTFE.
- For any given design load, the area required for a CDP bearing will be smaller than the equivalent elastomeric bearing.
- Pot bearings are only considered for extremely heavy design loads or unusual circumstances and designers should seek section leader approval before using them.
- Due to the ease and speed of bearing design, using the bearing design spreadsheet, designers may want to design both an elastomeric and a CDP bearing before deciding which type of bearing to use. Designers should discuss the options with their section leader if they are unsure which type of bearing may be the most appropriate or cost effective for a given application.

Bearing Layout

- Bearings will be placed in line with the girder and centered with the following:
  - Anchor bolts, if any.
  - CL of abutment for steel and concrete girders, usually 6" from end of the girder.
  - CL of Pier/bent for steel girders.
  - A minimum of 10" from CL of Pier/Bent for Prestressed NU and IT girders and a minimum of 7 1/2" for Double Tee girders.
- All elastomeric and CDP bearing pads shall be recessed 1/8" into the girder seat, the 1/8" recess must be shown in the plan view of the abutment and pier/bent sheets.
- Girder seat elevations are given to the top of the girder seat, not the bearing pad recess.
- Prestressed girder structures should use the maximum net girder camber in calculating the girder seat elevation.

305.03 – Sole Plates

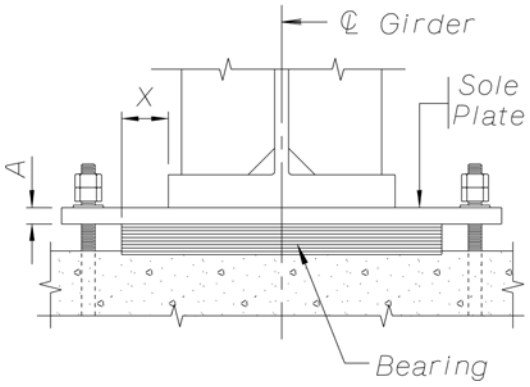
General

- Sole plates are used to anchor girders, distribute loads to bearings and reduce dead load bearing rotations.
- A beveled sole plate is required when the slope of the girder at the centerline of the bearing exceeds 1.0%.
- When beveled sole plates are used, they shall be beveled to match the girder slope as near as possible.
- When using a beveled sole plate, the direction of the bevel should be indicated on the plans.
- Anchor bolts or tie bars for fixed bearings shall be designed to resist lateral movements.
- A modified sole plate shall be used to improve fixity for fixed bearings with anchor bolts and bearing pads greater than 1 1/2” thick.

NDOR designers may use the Sole Plate Design spreadsheet in conjunction with Elastomeric or CDP bearing design in the bearing design spreadsheet bearings *(H:APPS/Bearings)*.

Thickness

The table at right may be used to determine minimum sole plate thickness. The average thickness of a beveled sole plate shall be used as its minimum thickness.



1.2 ksi Bearing Stress	
X	A min.
3½"	1½"
4"	1¾"
4¾"	2"

Length

The length of the sole plate is measured along the centerline of girder. Sole plates shall be a minimum of 3/4” longer than the bearing pad or the stainless steel plate when PTFE is used. Minimum sole plate length is 1’-0”.

Width

Sole plate width is measured perpendicular to the centerline of the girder. The sole plate will extend a minimum of 1 1/4” beyond the girder flange on each side of the girder. Where anchor bolts are used, a minimum of 1 1/4” is required between the edge of the bolt hole and the edge of the girder flange.

Stainless Steel Plate

- The minimum length of the stainless steel plate *(Lss)* shall be the greater of 11” or the following:

  For steel girder bridges

  Lss = 2TM + Pad Length

  For prestressed concrete girder bridges

  Lss = TM + Shrinkage + Creep + Pad Length

This will eliminate the problem of calculating accurate bearing placement based on temperature at the time of girder placement.

- The width of the stainless steel plate shall be the width of the bearing pad plus 3/4".
- The stainless steel plate shall be 0.07 in. minimum to 0.078 in. maximum thickness.

Anchor Bolt Holes/Slots

Holes and slot widths for anchor bolts should be the bolt diameter plus 1/4". The minimum slot length is 9" or two times the total calculated movement, plus 1/2", whichever is greater.

Modified Sole Plate

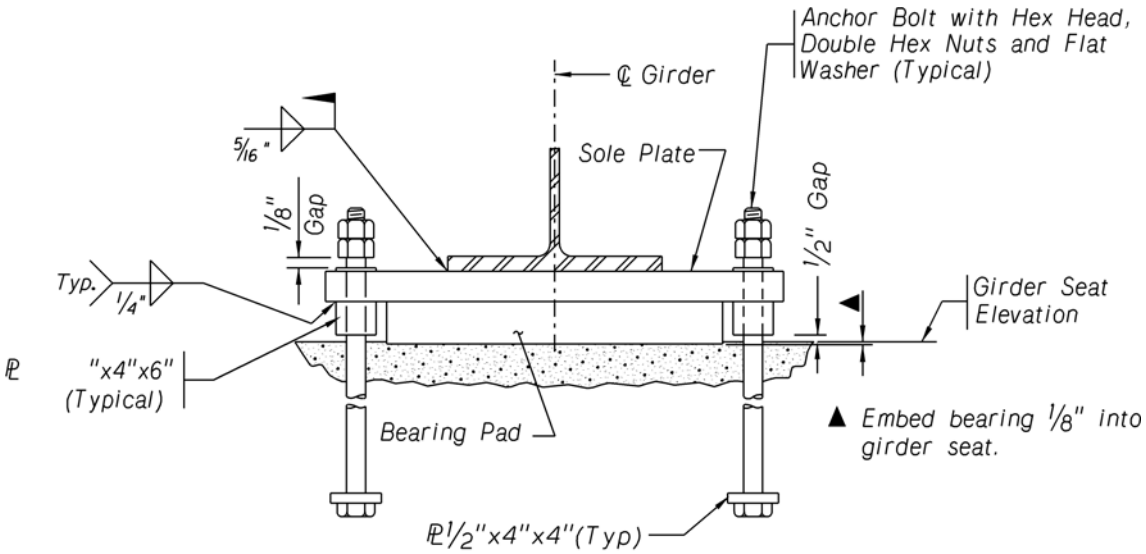
For a fixed bearing with anchor bolts, when bearing pad is greater than 1 1/2" thick, a 4"x6" plate shall be welded to the bottom of the sole plate centered on each bolt hole. Plate thickness shall be equal to the bearing height, minus 5/8" *[1/8– pad recess plus 1/2" for clearance].* The CADD cell AC=MSOLPL should be placed on the plans when modified sole plates are being used.

Sole Plate Placement

Slotted sole plates will be centered on the anchor bolts when the girder is placed. The CADD cell note AC=MSOLPL should be placed on the plans when modified sole plates are being used.

NOTE:

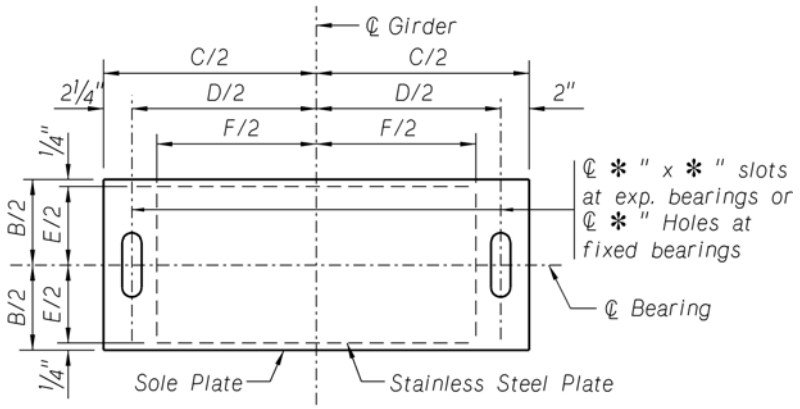
Sole plates shall be centered over the anchor bolts. AC = SOLNT1



FIXED BEARING WITH MODIFIED SOLE PLATE

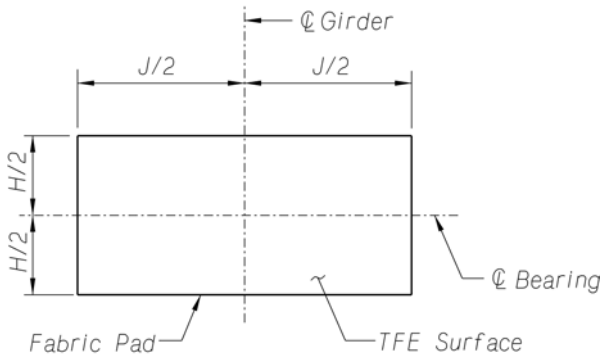
AC=MSOLPL

Sole Plate Details



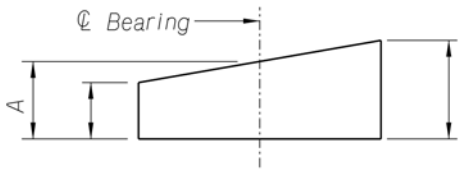
SOLE PLATE

AC=SOLEPL



FABRIC PAD

AC=SOLPAD



SECTION OF BEVELED SOLE PLATE

AC=SOLBEV

Note: Omit TFE low friction surface and stainless steel plate at fixed bearing device.

DIMENSIONS FOR BEARING DEVICES									
LOCATION	SOLE PLATE				STAINLESS STEEL		FABRIC PAD		
	A	B	C	D	E	F	G	H	J
Abutment No.									
Abutment No.									

AC = SOLTAB

305.04 – Elastomeric Bearing

General

- Elastomeric bearings rely on the pad elastic properties in shear to allow translational and rotational movement of the bridge.
- Bridge Office Policy specifies the use of AASHTO LRFD elastomeric bearing design Method "A" because it has been concluded that Method "B" will rarely, if ever, be cost effective.
- The material testing required for bearings designed using Method B could result in higher allowable design stresses, that could produce smaller *(less expensive)* bearings, but savings in the cost of the bearing are generally more than offset by the cost of the material tests.
- NDOR designers may use the Elastomeric bearing design spreadsheet in the bearing design spreadsheet Bearings *(H:APPS/Bearings)*.

Design Criteria

- Bearings are designed using service loads *(unfactored),* without impact.
- For reinforced elastomeric bearings, designers may use 60 durometer elastomer *(G = 130 psi)*.
- For plain elastomeric bearings, designers may use 60±5 durometer elastomer *(G = 200 psi).*
- Minimum elastomer thickness for plain pads and internal layers of reinforced pads is 3/8".
- All internal elastomeric layers of reinforced bearings will be equal thickness.
- Minimum elastomeric cover layer thickness is ¼".
- Minimum steel shim thickness is 11 gage, grade *(33-36)* – see Section C18.4.1.1.1 Division II interim 1997 AASHTO 17th edition.
- A minimum of *(2)* steel shims are required for reinforced bearings.
- Maximum total bearing thickness is 5" without Section Leader approval.

Horizontal Movement

- Elastomeric bearing pads for concrete structures shall be designed for the maximum horizontal movement Λs caused by temperature movement *(TM).*
- Elastomeric bearing pads for steel structures shall be designed for the maximum horizontal movement $\triangle s$ caused by temperature movement *(TM)*.

Rotation

Plain and reinforced elastomeric bearings will be designed for a minimum rotation of 0.005 radians plus the dead load rotation when a beveled sole plate is not used. Bearings will be designed for a minimum rotation of 0.005 radians when a beveled sole plate is used. A beveled sole plate is required when the girder slope equals for exceeds 1.0% *(0.010 Radians).* The minimum rotation requirement accounts for construction tolerance and live load rotation.

Note:

See Elastomeric Bearing Design Example or General Bearing Policy for additional design information.

ELASTOMERIC BEARING DESIGN EXAMPLE

The following example explains the steps used in the design spreadsheet shown in 3.5.4.4 and illustrates the required design information and the proper sequence of design calculations for elastomeric bearing design.

Design example assumptions:

- Reinforced expansion bearing required for load and movement conditions
- Slope of the girder at the centerline of bearing 0 = 0.0075 radians
- Service dead load per bearing DL = 158 kips
- Service live load per bearing LL = 77 kips
- Total bearing load DL+LL P = 235 kips
- Design horizontal movement Δ_s = 1.3 in.

Determine the elastomeric shear modulus.

G = 0.130 ksi AASHTO LRFD Table 14.7.5.2.-1/BOPP

Select a layer thickness for internal elastomeric layers.

h_{ri} = 0.5 in. *(design option BOPP minimum = 0.375 in.)*

Select elastomeric cover layer thickness.

h_{rc} = 0.25 in. *(design option)* AASHTO LRFD 14.7.6

$0.7h_{ri}$ = 0.7 * 0.5 = 0.35 in. 0.25 < 0.35 in. OK

Select number of internal elastomer layers to be used in design.

4 *(design option)*

Calculate total elastomer thickness.

$h_{rt} = 2h_{rc} + (4)h_{ri}$ = 2*0.25 + 4*0.5 = 2.5 in. AASHTO LRFD 14.7.6.3.4-1

$h_{rt} >= 2\Delta_s$ $2\Delta_s$ = 2*1.25 = 2.5 in. 2.5 in. = 2.5 in. OK

Select a bearing length.

L = 12.00 in. *(design option)*

Select a bearing width.

W = 20.50 in. *(design option)*

Calculate design bearing area.

A = LW = 12.00*20.50 = 246 in^2

Calculate shape factors.

$S_l = LW/(2h_{ri}(L+W)$ = 12.00*20.50/(2*0.5(12.00+20.50)) = 7.569

AASHTO LRFD 14.7.5.1-1

$S_c = LW/(2h_{rc}(L+W)$ = 12.00*20.50 / (2*0.25(12.00+20.50)) = 15.138

Calculate average compressive stress due to total service load.

o_s = P/A 235 kips/246 in^2 = 0.955 ksi

Where P = DL + LL = 158 + 77 = 235 kips

Calculate allowable compressive stress.

o_{A11} = minimum (1.0 ksi, 1.0GS) AASHTO LRFD 14.7.6.3.2-4

1.0 GS = 1.0*0.13*7.569 = 0.984 < 1.0 = o_{A11} = 0.984 ksi

o_s < = o_{A11} = 0.955 < 0.984 ksi OK

Note: The design spreadsheet makes this check by comparing design bearing area to minimum allowable bearing area based on allowable compressive stress. This is done to aid the designer when modifying bearing length and/or width.

Determine compression modulus modifier constant.

k = 0.6 For 60 durometer elastomer AASHTO 16th Edition 14.3.1

Calculate the effective elastomeric compression modulus.

$E_{ci} = 3G(1+(2kS_i^2)) = 3*0.13(1+(2*0.6*7.569^2)) = 27.203$ ksi

AASHTO 16th Edition 14.2

$E_{cc} = 3G(1+(2kSc^2)) = 3*0.13(1+(2*0.6*15.138^2)) = 107.643$ ksi

Calculate elastomeric compressive strain.

$\varepsilon_{ci} = P/(AE_{ci})$ = (235 kips) / (246 in^2*27.203 ksi) = 0.035

$\varepsilon_{cc} = P/(AE_{cc})$ = (235 kips) / (246 in^2*107.643 ksi) = 0.009

Note: Designers may use the equations above, or AASHTO LRFD Figure C14.7.5.3.4 to determine the compressive strains "ε_{ci}" and "ε_{cc}".

Calculate the instantaneous compressive deflection.

$\Delta_C = \Sigma\varepsilon h_r = 4\varepsilon_{ci}h_{ri} + 2\varepsilon_{cc}h_{rc} = 4*0.03*0.5 + 2*0.009*0.25 = 0.0747$ in.

AASHTO LRFD 14.7.5.3.3-1

Note: Instantaneous deflection is generally not a problem unless it results in a difference in roadway elevation across a joint in the pavement.

Calculate allowable rotation for design.

$0_{A11} = o_s/(0.5GS(L/h_{rt})^2) = 0.85/(0.5*0.13*7.569(12.00/2.5)^2) = 0.0843$ Radians

Where S = shape factor for thickest layer (Si)

AASHTO LRFD 14.7.6.3.5-1

Calculate required rotation.

0_{req} = 0 + 0.005 Radians = 0.0075 + 0.005 = 0.0125 Radians (BOPP)

$0_{req} < 0_{A11}$ = 0.0125 < 0.0843 Radians OK

Calculate average compressive stress due to live load only.

o_L = LL/A = (77 kips) / 246 in^2 = 0.313 ksi

Determine allowable steel shim fatigue stress.

F_{sr} = 24 ksi AASHTO LRFD 6.6.1.2.5-3

Define steel shim grade.

F_y = 33 ksi AASHTO 16th Edition, interim 1997 Division II C18.4.1.1.2

t_s = 11 gage = 0.1196 in. (BOPP minimum)

Check minimum allowable steel shim thickness (t_s min.)

$h_s = 3h_{ri}o_s/F_y = 3*0.5*0.955/33 = 0.0434$ in. (service limit state)

$h_s = 2h_{ri}o_L/F_{sr} = 2*0.5*0.313/24 = 0.0130$ in. (fatigue limit state)

Use BOPP minimum $t_s = 0.1196 > 0.0434$ OK

Calculate total bearing height

$T = h_{rt} + (5)h_s = 2.5 + 5*0.1196 \sim 3.098$ in.

Check stability

T < = L/3

3.098 < = 12.00/3 = 4.00 OK

NDOR Bridge Division – Elastomeric Bearing Design

Design spreadsheet based on AASHTO 16th Edition 1997 Interim (Method "A") / AASHTO LRFD

Enter values for all applicable shaded cells Refer to the BOPP manual for design information.

Bearing type (P – plain, R-reinforced)		R		
Bearing type (F – fixed, E – expansion)		E		
Dead load rotation	0	0.0075	Radians	[Slope of girder at the bearing]
Dead Load (unfactored)	DL	158	kips	[From computer program]
Live Load w/o impact (unfactored)	LL	77	kips	[From computer program]
Bearing design load	P	235	kips	[LL + DL from computer program]
Horizontal movement	Δs	1.25	in.	[The sum of the range of movement from all sources.]
Shear modulus	G	0.130	ksi	[AASHTO table 14.6.5.2-1]
Inner layer thickness	hrc	0.5	in.	[Arbitrary design value > = 0.40 in.]
Cover layer thickness	hrc	0.25	in.	[Arbitrary design value < = 0.7*hri.]
Design check		50.00	%	OK hrc < = 70% of hri
Number of inner layers	n	4		[Arbitrary design value.]
Total elastomer thickness	hrt	2.5	in.	[(2hrc + n*hn > = 2Delta s]
Design check	$2\Delta s$	2.5	in.	OK hrt.> =2*Delta s
Bearing length	L	12	in.	[Arbitrary design value]
Bearing width	W	20.5	in.	[Arbitrary design value]
Bearing area	A	246	in^2	[L*W]
Shape factor (inner layers)	S_i	7.569		[LW/(2*hri*(L+W))]
Shape factor (cover layers)	S_c	15.138		[LW/(2*hrc*(L+W))]
Average compressive stress	os	0.955	ksi	[os = P/A]
Allowable compressive stress	o all	0.984	ksi	[Min. (7.0, 1.0GS)]
Design check	Amin	239	in^2	OK Amin < A
Modifier constant	k	0.6	[AASHTO table 14.3.1]	
Compression modulus (inner layer)	Eci	27.203	ksi	[3*G*(1+2*k*S_i^2))]
Compression modulus (cover layer)	Ecc	107.643	ksi	[3*G*(1+(2*k*Sc*2))]
Compressive strain (inner layer)	Eci	0.035	[P/(A*Eci)]	
Compressive strain (cover layer)	Ecc	0.009	[P/(A*Eci)]	
Instantaneous deflection	Δc	0.09	in [Δc=Σechr] [BOPP max = 0.2 inch in deck joint locations]]	
Allowable rotation	0 All	0.0843	Radians [0All=o/.5GS(L/hrt)^2]	
Design check	0 req	0.0125	Radians OK Theta All>=Theta req.	
Average compressive stress (LL only)	oL	0.313	kips [LL/A]	
Allowable fatigue stress	Fer	24.0	kips [AASHTO table 10.3.1A category A over 2000000 cycles]	
Shim steel grade		33.0	kips [1997 interim AASHTO Division II, C18.4.1.1.2]	
Shim thickness	ts	0.1196	in. [Arbitrary design value] [BOPP minimum = 11 gage = 1/8"]	
Design check	ts min	0.043	in. OK Meets AASHTO equations 14.6.5.3.7-1&2, & BOPP	
Total bearing height	T	3.098	in. [includes shims]	
Design check	L/3	4.00	in. Stability Check OK T <=L/3	
BEARING DESIGN OK				

305.05 – Cotton Duck Pad

General

- Cotton duck pads *(CDP's)* can accommodate very large compressive loads, and appear to provide adequate rotation capacity based on past NDOR experience.
- A PTFE sliding surface is required to accommodate horizontal movement. CDP design is governed by allowable concrete and PTFE stresses.
- A masonry plate will not be used with CDP's.
- Generally, pads with the least volume have the lowest manufacturing cost. Minimizing the length will reduce the volume because thickness is a function of length.
- All CDP bearings are designed assuming a rotation of 0.015 radians.
- NDOR designers may use the CDP design spreadsheet in the Bearing Design spreadsheet Bearings *(DORDOMNT1/DORIMAGE1/BRIDGE/APPS/BEARINGS)*.

Design Criteria

- Maximum pad thickness *(t)* = 3"
- Minimum pad length *(L)* = 4"
- Design load *(P)* = DL + LL *(unfactored)*
- Allowable pad compressive stress *(o)* = 1.50 ksi

Design Procedure

1. Calculate design load *(P)*
2. Calculate pad area *(A)* $A = P / o$
3. Assume a pad width *(W)*
4. Calculate pad length *(L)* $L = A / W$
5. Calculate pad thickness *(t)* $t = L / 5.3$*

* The factor 5.3 was derived, in part, based on a design rotation of 0.015 radians.

Note:

See **General Bearing Policy** for additional design information.

305.06 – Confined Elastomeric *(POT)* Bearing

General

The confined elastomeric *(POT)* bearing was developed in 1959 as an alternate to heavy steel bearings. The bearing consists of a circular nonreinforced rubber pad, which is totally enclosed by a steel pot. The rubber is prevented from bulging by the pot containing it and acts similar to a fluid under high pressure.

Although experience has shown the pot bearing to be compact and efficient, it has been the most expensive bearing alternate. A final concern is the fact that satisfactory rotational operation of the bearing is not achieved until at least 25% of the working load is applied; therefore, additional consideration must be given to erection procedures.

Width and length of pedestals, if used with pot bearing, should allow for at least 6” clear edge distance to the base plate that will be provided by the manfacturer.

Design Criteria

The service load design information will be shown in the data table on the bearing sheets for each bearing location. More design criteria may be specified in the standard data tables at the designer’s preference.

The lateral load provided by the pot bearing manufacturer may be assumed 10 percent of the total vertical load. If required, designers may specify more on the plans.

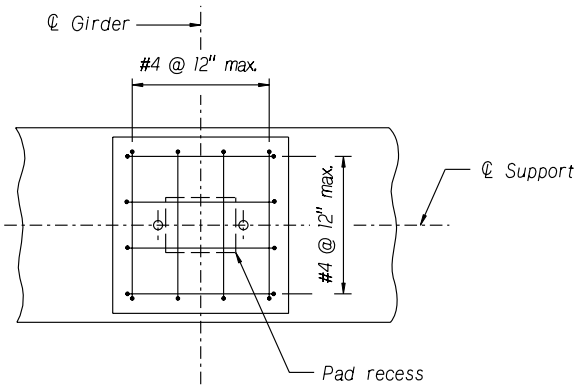
Pot Bearing Base Sheets

There are two base sheets available in Chapter 6. See 6.2.8 and 6.2.9 for Pot bearing details and level options.

305.07 – Bearing Pedestal Policy

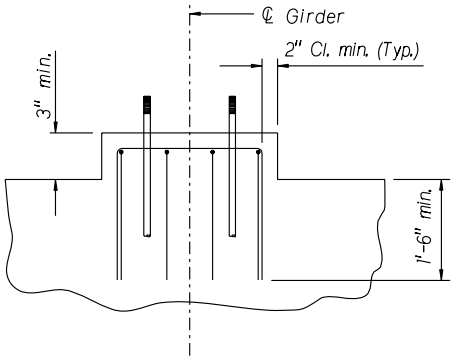
General

- The Bridge Division policy is to use pedestals for all expansion bearings for girder bridges except Inverted Tee and Twin Tee girder bridges.
- Pedestals shall provide adequate lateral resistance for expansion bearings, especially for skewed bridges and where anchor bolts are not used.
- Pedestals up to 1'-0" in height shall be poured monolithically with the abutment, pier, or bent.
- The elevation of each pedestal shall be shown on the plans.



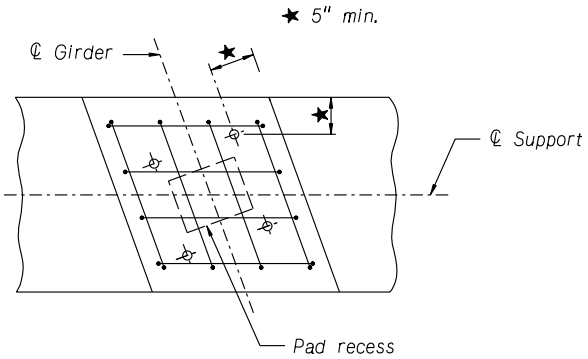
Pedestal Layout

- Pedestals must be shown on the plans.
- Pedestal minimum height is 4".
- Bearings must have 6" minimum clear edge distance to any vertical concrete face.
- Pedestals shall be the same width as the pier cap or abutment cap *(slab turndown).*
- When slab turndowns or concrete diaphragms are placed at supports, longitudinal edges of the pedestals should be parallel to the direction of movement. This will prevent the pedestal from interfering with the super-structure expansion.
- Bearing pads shall be recessed 1/8" to prevent the pad from walking.



Reinforcement

- Pedestals will be provided with U-shaped steel reinforcement.
- The minimum reinforcement will be #4 at 6" centers in both directions.
- The minimum concrete cover shall be 2" to any face of the pedestal.



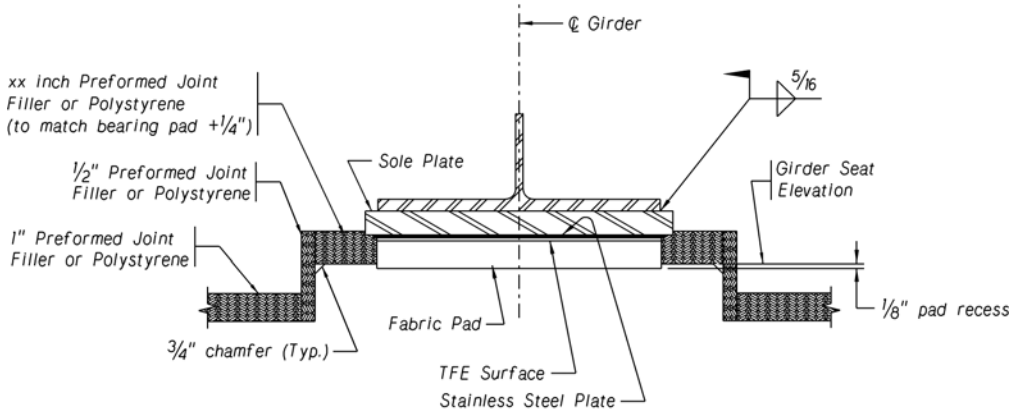
Anchor Bolts

- Anchor bolts must have a 5" minimum clear edge distance to the nearest vertical concrete face.

Note:

Anchor bolts shown in conjunction with pedestals are for illustration purpose only; the use of anchor bolts with pedestals should be based on the Anchor Bolts guidelines discussed in General Bearing Policy.

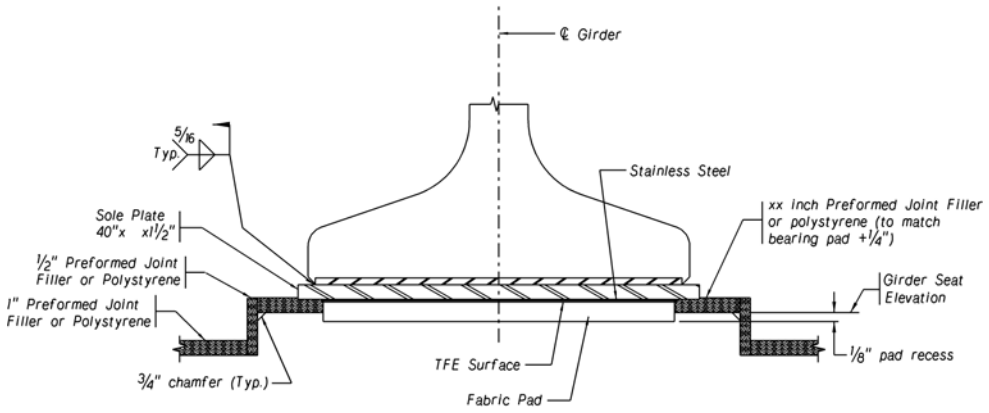
305.08 – Bearing Details



SECTION AT EXPANSION BEARING (TFE TYPE)

AT ABUTMENTS

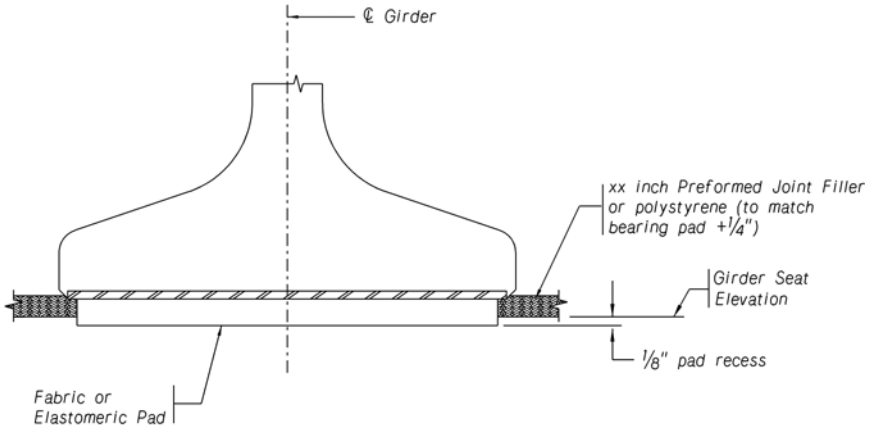
AC=BRGND1



SECTION AT EXPANSION BEARING (TFE TYPE)

AT ABUTMENTS OR PIERS

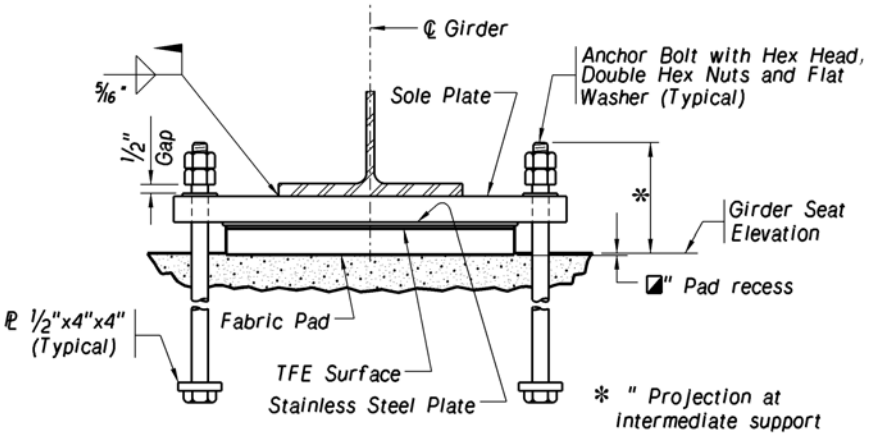
AC=BRGND2



SECTION AT FIXED BEARING

AT ABUTMENTS OR PIERS

AC=BRGND3



SECTION AT EXPANSION BEARING (TFE TYPE)

AC=TFESG

305.09 – Bearing Shop Plan Policy

The Bridge Division will be responsible for confirming each applicable item is shown on the Bearing Shop Plans. Checkers should refer to the Standard Specifications and Special Provisions to identify which of the following items are required on a Bearing Shop Plan.

Sole Plates *(Upper Assemblies)*

1. Sole plates shall conform to the requirements of ASTM A 709 Grade 50W weathering steel.
2. As an alternate, the sole plate may be grade 36 steel, metallized. If the grade 36 alternate is used, all flame cut edges of the sole plate shall be ground to reduce hardness and facilitate blast cleaning. All corners of the sole plate shall be rounded to a 1/16-inch radius. All exposed plan steel surfaces shall be blast cleaned to a near white finish and zinc metallized with a minimum thickness of 8 mils. Zinc metallizing must be performed in accordance with American Welding Society Specification AWS C2.2.
3. An ASTM A 240 Type 304 stainless steel plate *(minimum 70 mils to a maximum of 80 miles thickness)* shall be attached to the lower surface of expansion bearing sole plates *(not applicable to fixed bearing plates).*
4. The stainless steel plate in contact with the TFE sheet shall be polished or rolled to provide a Number B mirror finish.
5. The stainless steel plate shall be attached by welding around its full perimeter.
6. Welding may be done with the shielded metal arc welding process using an AWS E308L-15 electrode, the gas metal arc process using an AWS ER308L electrode, or the gas tungsten arc welding process using an AWS ER308L fillermetal.
7. The weld shall not extend into the area of contact between the upper and lower assemblies.

Bearing Pads *(Lower Assemblies)*

1. Bearing pads shall consist of a cotton duck reinforced elastomeric pad (CDP) conforming to the requirements of the current AASHTO Standard Specifications for Highway Bridges and the Department of Defense Specification MIL-C-882.
2. The lower assembly for expansion bearings shall consist of a CDP pad with a 94 mil thick, low friction, virgin, unfilled, polytetrafluroethylene *(TFE)* sheet bonded to the upper surface.
3. Bonding of the TFE shall meet the peel test requirements *(ASTM D903)* of 25 lb/in at an angle of 180 degrees.
4. Bonding must be complete without air gaps under the TFE sheet to seal out moisture and provide a smooth, flat slide surface.
5. The TFE sheet shall conform to the requirements of the AASHTO Standard Specifications for Highway Bridges and these NDOR Standard Specications.

Flatness

1. Flatness shall be tested in accordance with Section 712 of the NDOR 1997 Standard Specifications.
2. The flatness tolerance for the TFE sheet and the stainless steel plate shall be 0.0005 x “Nominal Dimension”.

SECTION 306: Safety Barrier Policies

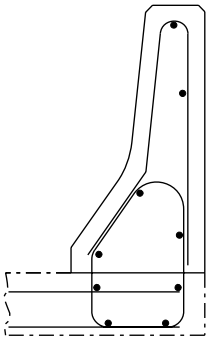
306.01 – Concrete Barrier Policy

Design Criteria

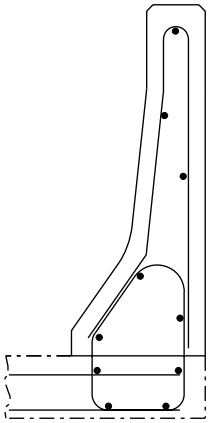
The concrete barrier consists of a 2'-8" or 3'-6" high New Jersey shaped section. The height of the concrete barrier will be determined on the Bridge Data sheet for eac project. The 1'-4" base width of concrete barriers should be transitioned over a length of 1'-8", when extending existing 1'-3" wide concrete barriers. All layout dimensions for the barrier will be measured at the gutter line *(front face)* of the barrier.

Reinforcement

There are two cells available for general detailing as shown below.



2'-8" Concrete Barrier
AC=CBARR1
Sectional area = 2.302 sq.ft.
Unit Weight = 345.3 plf
Gutter line to C.G. = 10 1/2"



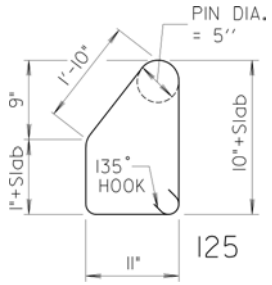
3'-6" Concrete Barrier
AC=CBARR2
Sectional area = 2.754 sq.ft.
Unit Weight = 413.09 plf
Gutter line to C.G. = 11"

Longitudinal Bars

All longitudinal bars in the concrete barrier will be #4 bars and placed as shown in the details above. In addition, there will be four continuous bars placed in the bridge deck as shown in the bridge base sheets.

Stirrups

The 123, 125, and 126 type stirrups will match a spacing provided in the bridge deck, up to a maximum spacing of 1'-3". The bending diagrams for the 123 and 126 type stirrups are located in the bill of bars. General bending information for type 125 stirrup shown by the sketch at the is right.



125 Closed Stirrup
(125) Length = 3'-9" x 2* (Slab Thickness)

Bridge Widenings

Existing bridges should be investigated to determine deviations from the standard barrier layouts.

Embankment Protection

Embankments above high water elevations are subject to compounding erosion from deck drainage. Designers should be aware of erosion problems that may exist on site and should recommend appropriate action to protect embankments.

Payment

Quantities for barrier concrete and reinforcement will be indicated under the appropriate pay items for Class 47BD and epoxy-coated reinforcing steel as stated in the following paragraphs.

The portion of the barrier concrete placed on the bridge deck will be listed as a subitem under Class 47BD-4000 for Bridges. The portion of the barrier steel placed on the approach slab will be included in the pay item Epoxy Coated Reinforcing Steel for Pavement Approaches. Concrete Barrier quantities will include the bars placed in the deck *(slab).*

Bridge Base Sheets

The Bridge Division has a reference file, see Chapter 6, that contains the 2'-8" and 3'-6" concrete barriers on the same sheet, but on different levels.

2’-8” Concrete Barrier – with block out – Quantities on Approach Slabs

If the base sheet is not altered, the following quantities apply:

Concrete for 2’-8” Barrier on Approach Slabs

Buttress =	1.22	Cu.Yd.
Transition Shape =	0.78	Cu.Yd.
Barrier Shape =	0.54	Cu.Yd.
Subtotal for one End =	2.54	Cu.Yd.
Total = Sub x 4 ends =	10.16	Cu.Yd.

2’-8” Concrete Barrier on Approach Slabs *(Standard Layout, Four Ends)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
*N690	112	5’-10”	104	3’-2”	2’-8”				4 1/2”		981.3
*N590	24	14’-4”	125	4’-8”	1’-6”	6’-1”	10”	1’-5”	2 1/2”	5 1/2”	354.1
*N591	32	11’-9”	107	4’-7”	10”				2 1/2”	5 1/2”	392.2
*N592	8	7’-11”	107	2’-8”	10”				2 1/2”	5 1/2”	66.1
N593	64	6’-6”	104	3’-3”	3’-3”				2 1/2”		433.9
N594	24	6’-8”	125	1’-3”	1’-2”	2’-1”	1’-0”	10”	2 1/2”	5 1/2”	166.9
*N490	12	1’-6”	STR								12.0
*N491	64	2’-0”	STR								85.5
N492	28	4’-11”	123						2”		92.0
N493	56	8’-10”	STR								330.4

* Buttress bars

Total (Lbs) = 2915

2'-8" Concrete Barrier – without block out – Quantities on Approach Slabs

If the base sheet is not altered, the following quantities apply:

Concrete for 2'-8" Barrier on Approach Slabs

Buttress =	1.28	Cu.Yd.
Transition Shape =	0.78	Cu.Yd.
Barrier Shape =	0.54	Cu.Yd.
Subtotal for one End =	2.60	Cu.Yd.
Total = Sub x 4 ends =	10.40	Cu.Yd.

2'-8" Concrete Barrier on Approach Slabs *(Standard Layout, Four Ends)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
*N690	176	5'-10"	104	3'-2"	2'-8"				4 1/2"		1542.1
*N590	24	14'-4"	125	4'-8"	1'-6"	6'-1"	10"	1'-5"	2 1/2"	5 1/2"	354.1
*N591	40	11'-9"	107	4'-7"	10"				2 1/2"	5 1/2"	490.3
N593	64	6'-6"	104	3'-3"	3'-3"				2 1/2"		433.9
N594	24	6'-8"	125	1'-3"	1'-2"	2'-1"	1'-0"	10"	2 1/2"	5 1/2"	166.9
*N490	12	1'-6"	STR								12.0
N492	28	4'-11"	123						2"		92.0
N493	56	8'-10"	STR								330.4

* Buttress bars

Total (Lbs) = 3422

2'-8" Concrete Barrier on Bridge Deck

All calculations shown below are based on the length of the bridge from E.O.F. to E.O.F. and the thickness of the bridge deck. Bold boxes in the bill of bar list indicate information that varies base on the EOF to EOF length.

Thickness Deck Slab = 7 1/2"
EOF to EOF = 98'-5"

Concrete for 2'-8" Barrier on the Bridge		
(One side of Rail)	8.24	Cu.Yd.

Concrete Quantity = 2 x one side = **16.48** Cu.Yd.

2'-8" Concrete Barrier on the Bridge *(Standard Layout, Two Sides)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
S590	166	5'-5"	125	9"	1'-2"	1'-7"	1'-0"	10"	2 1/2"	5 1/2"	927.4
S490	170	4'-11"	123						2"		558.6
*S491	10	102'-1"	STR								682.3

* includes 2 – 2'-0" LAPS

Total (Lbs) = **2168.3**

3’-6” Concrete Barrier – with block out – Quantities on Approach Slabs

If the base sheet is not altered, the following quantities apply:

Concrete for 3’-6” Barrier on Approach Slabs

Buttress =	1.22	Cu.Yd.
Transition Shape =	0.86	Cu.Yd.
Barrier Shape =	0.67	Cu.Yd.
Subtotal for one End =	2.75	Cu.Yd.
Total = Sub x 4 ends =	11.00	Cu.Yd.

3’-6” Concrete Barrier on Bill of Bars *(Standard Layout, Four Ends)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
*N690	112	5’-10”	104	3’-2”	2’-8”				4 1/2”		981.3
*N590	24	14’-4”	125	4’-8”	1’-6”	6’-1”	10”	1’-5”	2 1/2”	5 1/2”	354.1
*N591	32	11’-9”	107	4’-7”	10”				2 1/2”	5 1/2”	392.2
*N592	8	7’-11”	107	2’-8”	10”				2 1/2”	5 1/2”	66.1
N593	64	7’-4”	104	3’-3”	4’-1”	Max.			2 1/2”		461.7
					3’-3”	Min.					
N594	24	6’-8”	125	1’-3”	1’-2”	2’-1”	1’-0”	10”	2 1/2”	5 1/2”	166.9
*N490	12	1’-6”	STR								12.0
*N491	64	2’-0”	STR								85.5
N492	28	6’-5”	126								120.0
N493	72	8’-10”	STR								424.8

* Buttress bars

Total (Lbs) = 3065

Mark	Max. Length	Min. Length	No. Sets	Bars Per Set
N593	7’-4”	6’-6”	8	8

3'-6" Concrete Barrier – without blockout – Quantities on Approach Slabs

If the base sheet is not altered, the following quantities apply:

Concrete for 3'-6" Barrier on Approach Slabs

Buttress =	1.28	Cu.Yd.
Transition Shape =	0.86	Cu.Yd.
Barrier Shape =	0.67	Cu.Yd.
Subtotal for one End =	2.81	Cu.Yd.
Total = Sub x 4 ends =	11.24	Cu.Yd.

3'-6" Concrete Barrier on the Bridge *(Standard Layout, Four Ends)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
*N690	176	5'-10"	104	3'-2"	2'-8"				4 1/2"		1542.1
*N590	24	14'-4"	125	4'-8"	1'-6"	6'-1"	10"	1'-5"	2 1/2"	5 1/2"	354.1
*N591	40	11'-9"	107	4'-7"	10"				2 1/2"	5 1/2"	490.3
N593	64	7'-4"	107	3'-3"	4'-1"	Max.			2 1/2"		461.7
					3'-3"	Min.			2 1/2"		461.7
N594	24	6'-8"	125	1'-3"	1'-2"	2'-1"	1'-0"	10"	2 1/2"	5 1/2"	166.9
*N490	12	1'-6"	STR								12.0
N492	28	6'5"	STR								120.0
N493	72	8'-10"	STR								424.8

* Buttress bars

Total (Lbs) = 3572

Mark	Max. Length	Min. Length	No. Sets	Bars Per Set
N593	7'-4"	6'-6"	8	8

3’-6” Concrete Barrier on Bridge Deck

All calculations shown below are based on the length of the bridge from E.O.F. to E.O.F. and the thickness of the bridge deck. Bold boxes in the bill of bar list indicate information that varies base on the EOP to EOP length.

Thickness Deck Slab =	8”
EOF to EOF =	98’-5”

Concrete for 3’-6” Barrier on the Bridge

Barrier (One side)	10.20	Cu.Yd.
Concrete Quantity = 2 x one side =	20.4	Cu.Yd.

3’-6” Concrete Barrier on Approach Slabs *(Standard Layout, Two Sides)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
S590	166	5’-8”	125	9”	1’-2”	1’-7”	1’-0”	10”	2 1/2”	5 1/2”	941.9
S490	170	6’-6”	126						2”		719.6
*S491	12	102’-1”	STR								818.7

* includes 2 – 2’-0” LAPS

Total (Lbs) = 2480.2

306.02 – Concrete Rail Policy

General Design Criteria

Vertical and horizontal layout dimensions shall be measured at the front face of rail.

Open Concrete Rail

Open concrete rail should be used on all bridges except locations where existing New Jersey sections predominate. Open rail layouts will use the following design criteria:

Open concrete rail on bridge *(see Bridge Loading)*	= 270 plf
Standard post spacing CL to CL	= 8'-0"
Clear maximum between face of posts	= 7'-1"
Clear maximum rail cantilever from face of a post	= 1'-0"

Closed Concrete Rail

Closed concrete rail should be used from end to end with an adjoining sidewalk. The designer should consider using the closed section only where required on the bridges over recreational trails, sidewalks, vehicle, or railroad traffic.

Unit weight of closed concrete rail on bridge = 382 plf

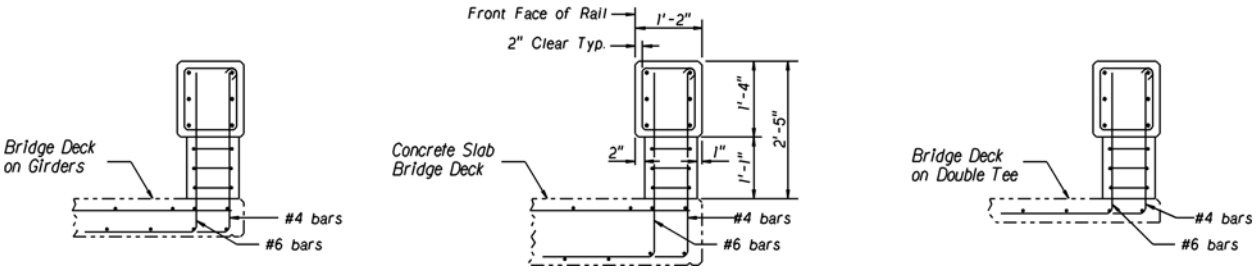
Vertical Post Reinforcement

The height of the vertical leg of the "L" shaped reinforcement will be sized to fit the bridge deck. The vertical leg will be designed to provide 3" minimum clearance to the top of the rail. In all applications, the bottom leg will match the transverse steel provided in the concrete slab.

Designers should note that the location of Double Tee cast-in-place deck reinforcement is based on a 5" minimum deck thickness. The clear distance from the top of the girder flange to the transverse steel (3/4") will remain constant for all points along the rail. The variance of the deck may be ignored for girder cambers less than 2".

Rail systems will be reinforced as shown on the Concrete Rail Base Sheets. Full or partial closed rail systems should modify layouts based on the typical reinforcements shown in the Concrete Rail Base Sheets, see Chapter 6.

The following details illustrate the various types of deck steel layouts. A cell, AC=CRAIL, of the rail only is available for detailing.



Typical Rail Sections **AC = CRAIL**

Bridge Widening

Existing bridges should be investigated to determine deviations from the standard rail layouts.

Embankment Protection

Embankments above high water elevations are subject to compounding erosion from open concrete rail drainage. Designers should be aware of erosion problems that may exist on-site and should recommend appropriate action to protect stream embankments.

Payment

Quantities for rail reinforcement and concrete will be indicated under the appropriate pay items for Class 47BD Concrete and Epoxy Coated Reinforcing Steel. In other words, quantities for the portion of concrete rail placed on the bridge deck will be listed as subitems under the bridge pay items. Quantities for the portion of concrete rail placed on the bridge approach slab will be listed as subitems under the pay items for the approach slab.

Bridge Base Sheets

There is a Base Sheet, see Chapter 6, which contains five sheets *(A, B, C, D, and F)* described below.

Sheet A

Shows the details for the section of open concrete rail on the approach sections.

Sheet B

Shows the details for the section of open concrete rail on the bridge deck. The following information must be provided by the designer on the base sheet:

1. Length of bridge from EOF to EOF
2. Length of variable first post spacing on the bridge.
3. Number of 8 ft. post spaces.
4. Vertical post reinforcement detail Section A-A:

   Deck on girders ..... Level 50
   Slab bridge ..... Level 51
   Double Tee Girders ..... Level 52

5. Rail vertical reinforcement, placed in the bridge deck *(slab),* must be customized by the designer to fit the bridge deck.

Sheet C

Shows the details for Closed Concrete Rail on the approach sections.

Sheet D

Shows the details for Closed Concrete Rail on the bridge deck.

Sheet F

Shows the details for Part Open Concrete Rail on the bridge deck.

Open Concrete Rail – with block out – Quantities on Approach Slabs

If the base sheet is not altered, the following quantities apply:

Concrete for Open Rail on Approach Slabs

Buttress =	1.22	Cu.Yd.
Transition shapes =	0.07	Cu.Yd.
Rail =	0.82	Cu.Yd.
One 2'-0" Post =	0.07	Cu.Yd.
One 3'-0" Post =	0.12	Cu.Yd.
Subtotal *(one end)* =	2.30	Cu.Yd.
Total = Sub x 4 =	9.2	Cu.Yd.

Open Concrete Rail on the Bridge *(Standard Layout, Four Ends)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
*N690	112	5'-10"	104	3'-2"	2'-8"				4 1/2"		981.3
N691	36	5'-0"	104	3'-0"	2'-0"				4 1/2"		270.4
*N590	24	14'-4"	125	4'-8"	1'-6"	6'-1"	10"	1'-5"	2 1/2"	5 1/2"	354.1
*N591	32	11'-9"	107	4'-7"	10"				2 1/2"	5 1/2"	392.2
*N592	8	7'-11"	107	2'-8"	10"				2 1/2"	5 1/2"	66.1
N593	24	15'-5"	STR								385.9
*N490	12	1'-6"	STR								12.0
*N491	64	2'-0"	STR								85.5
N492	8	4'-9"	101	3'-9"	1'-0"	1"			2 1/2"		25.4
N493	48	4'-4"	104	3'-0"	1'-4"				3"		138.9
N391	32	4'-4"	107	1'-0"	10"				1 1/2"	4"	52.1
N392	12	7'-2"	107	2'-8"	7"				1 1/2"	4"	32.3
N393	12	5'-2"	107	1'-8"	7"				1 1/2"	4"	23.3

* Buttress bars

Total (Lbs) = 2820

Open Concrete Rail – without block out – Quantities on Approach Slabs

If the base sheet is not altered, the following quantities apply:

Concrete for Open Rail on Approach Slabs

Buttress =	1.28	Cu.Yd.
Transition shapes =	0.07	Cu.Yd.
Rail =	0.82	Cu.Yd.
One 2'-0" Post =	0.07	Cu.Yd.
One 3'-0" Post =	0.12	Cu.Yd.
Subtotal *(one end)* =	2.36	Cu.Yd.
Total = Sub x 4 =	9.44	Cu.Yd.

Open Concrete Rail on Approach Slabs *(Standard Layout, Four Ends)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
*N690	176	5'-10"	104	3'-2"	2'-8"				4 1/2"		1542.1
N691	36	5'-0"	104	3'-0"	2'-0"				4 1/2"		270.4
*N590	24	14'-4"	125	4'-8"	1'-6"	6'-1"	10"	1'-5"	2 1/2"	5 1/2"	354.1
*N591	40	11'-9"	107	4'-7"	10"				2 1/2"	5 1/2"	490.3
N593	24	15'-5"	STR								385.9
*N490	12	1'-6"	STR								12.0
N492	8	4'-9"	101	3'-9"	1'-0"	1"			2 1/2"		25.4
N493	48	4'-4"	104	3'-0"	1'-4"				3"		138.9
N391	32	4'-4"	107	1'-0"	10"				1 1/2"	4"	52.1
N392	12	7'-2"	107	2'-8"	7"				1 1/2"	4"	32.3
N393	12	5'-2"	107	1'-8"	7"				1 1/2"	4"	23.3

* Buttress bars

Total (Lbs) = 3327.2

Open Concrete Rail Quantities on Slab Bridge

All calculations shown below are based on the length of the bridge from EOF to EOF and the thickness of the bridge deck. Bold boxes in the bill of bar list indicate information that varies based on the EOF to EOF length.

Slab Thickness =	24”
EOF to EOF =	98’-5”

Concrete for Open Rail on the Bridge

First Post Space =	6’-8 1/2”	
Number of 2’-0” Posts =	11	
Rail *(One Side)* =	5.63	Cu.Yd.
Volume of 2’-0” posts =	0.78	Cu.Yd.
Volume of 2 End Posts =	0.24	Cu.Yd.
Subtotal *(one side)* =	6.65	Cu.Yd.
Total = Sub x 2 sides =	13.3	Cu.Yd.

Open Concrete Rail on Approach Slabs *(Standard Layout, Two Sides)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
S691	108	6’-0”	104	4’-0”	2’-0”				4 1/2”		952.3
*S591	12	102’-1”	STR								1283.3
S491	108	5’-4”	104	4’-0”	1’-4”				3”		378.9
S391	104	4’-4”	107	1’-0”	10”				1 1/2”	4”	162.1
S392	12	7’-2”	107	2’-8”	7”				1 1/2”	4”	31.4
S393	66	5’-2”	107	1’-8”	7”				1 1/2”	4”	123.4

* includes 2 – 2’-0” LAPS

Total (Lbs) = 2931.4

Open Concrete Rail – with block out – Quantities on Approach Slabs

If the base sheet is not altered, the following quantities apply:

Concrete for Closed Rail on Approach Slabs

Buttress =	1.22	Cu.Yd.
Transition shapes =	0.02	Cu.Yd.
Rail =	1.34	Cu.Yd.
Subtotal *(one end)* =	2.58	Cu.Yd.
Total = Sub x 4 =	10.32	Cu.Yd.

Closed Concrete Rail on Approach Slabs *(Standard Layout, Four Ends)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
*N690	112	5’-10”	104	3’-2”	2’-8”				4 1/2”		981.3
*N590	24	14’-4”	125	4’-8”	1’-6”	6’-1”	10”	1’-5”	2 1/2”	5 1/2”	354.1
*N591	32	11’-9”	107	4’-7”	10”				2 1/2”	5 1/2”	392.2
*N592	8	7’-11”	107	2’-8”	10”				2 1/2”	5 1/2”	66.5
N593	40	15’-5”	STR								643.2
N594	112	4’-8”	104	3’-0”	1’-8”				3 3/4”		545.1
*N490	12	1’-6”	STR								12.0
*N491	64	2’-0”	STR								85.5
N492	8	4’-9”	101	3’-9”	1’-0”	1”			2”		25.4
N391	32	4’-4”	107	1’-0”	10”				1 1/2”	4”	52.1

*Buttress bars

Total (Lbs) = 3158

Closed Concrete Rail – without block out – Quantities on Approach Slabs

If the base sheet is not altered, the following quantities apply:

Concrete for Closed Rail on Approach Slabs

Buttress =	1.28	Cu.Yd.
Transition shapes =	0.02	Cu.Yd.
Rail =	1.34	Cu.Yd.
Subtotal *(one end)* =	2.64	Cu.Yd.
Total = Sub x 4 =	10.56	Cu.Yd.

Closed Concrete Rail on Approach Slabs *(Standard Layout, Four Ends)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
*N690	176	5’-10”	104	3’-2”	2’-8”				4 1/2”		1542.1
*N590	24	14’-4”	125	4’-8”	1’-6”	6’-1”	10”	1’-5”	2 1/2”	5 1/2”	354.1
*N591	40	11’-9”	107	4’-7”	10”				2 1/2”	5 1/2”	490.3
N593	40	15’-5”	STR								643.2
N594	112	4’-8”	104	3’-0”	1’-8”				3 3/4”		545.1
*N490	12	1’-6”	STR								12.0
N492	8	4’-9”	101	3’-9”	1’-0”	1”			2”		25.4
N391	32	4’-4”	107	1’-0”	10”				1 1/2”	4”	52.1

*Buttress bars

Total (Lbs) = 3665

Closed Concrete Rail Quantities on Bridge Deck

All calculations shown below are based on the length of the bridge from EOF to EOF and the thickness of the bridge deck. Bold boxes in the bill of bar list indicate information that varies based on the EOF to EOF length.

Thickness Deck Slab =	8”
EOF to EOF =	98’-5”

Concrete for Closed Rail on the Bridge

(One side of Rail) =	9.2	Cu.Yd.
Total = x 2 =	18.4	Cu.Yd.

Closed Concrete Rail on the Bridge *(Standard Layout, Two Sides)*

Mark	No.	Length	Type	A	B	C	D	E	Pin	Hook	Lbs.
*S590	20	102’-1”	STR								2138.8
S591	388	5’-6”	104	2’-9”	2’-9”				3 3/4”		2167.7
S391	102	4’-4”	107	1’-0”	10”				1 1/2”	4”	158.9

*includes 2 – 2’-0” LAPS

Total (Lbs) = 4465.4

306.03 – Pedestrian Barrier Rail Policy

Layout

All pedestrian barrier rails will be designed to accommodate bicycle traffic. The maximum post spacing will be 8 ft., except at expansion joints.

At expansion joints, the posts on either side of the joint will be spaced preferably at a maximum of 5 ft. between posts.

Base Sheets

Two base sheets are currently available which show a pedestrian barrier rail placed on a closed concrete rail or a 2'-8" New Jersey section *(see Chapter 6).*

Payment

Pedestrian barrier rail shall be paid for using the pay item, Pedestrian Barrier Rail. Measurement shall be indicated on the plans as the distance *(in ft)* between the outermost bolts placed in the concrete rail as shown on the base sheet.

306.04 – Pedestrian Railing (Chain-Link Type)

Layout

The Bridge Division's current policy is to provide an 8'-3" high, curved chain-link fence on all bridges that are over traffic or railroads. This is to provide protection from falling debris for the traffic below. Chain-link fence will be a straight 5 ft. high section when bridges are not over traffic or railroad. All fence layouts should be located on the bridge using dimensions from the end*(s)* of the bridge floor at the CL of the fence. The maximum post spacing will be 8 ft. for all posts. For consistent bracing details, the first 8 ft. post spacing of the 8'-3" high pedestrian rail will remain unchanged and the second post spacing should vary to accommodate any odd lengths required.

Expansion Joints

Expansion joints will be provided in the top rail and handrail at all bridge expansion locations in the bridge deck. Typical fence bracing should be provided on both sides of expansion joints.

Expansion gaps should be designed for a fixed dimension *(i.e., no adjustments for temperature at time of installation).* Expansion gaps greater than 2" should use a longer pipe on the inside of the joint. All expansion gap information must be added to the base sheet by the designer. It is not shown by default, since there is not an expansion joint required in the base sheet fence layout.

Base Sheets

One base sheet is currently available for the 8'-3" high pedestrian rail *(chain-link type)* which has 5 ft. high sections at the ends. Alternate sketches level 50 for New Jersey section and level 51 for Closed Concrete Rail. See Chapter 6 for base sheet information. The following minimum information will be provided in the base sheets.

1. The clear dimension of the sidewalk should be indicated on the "Typical Section Thru Fence".
2. "Typical Section Thru Fence" will indicate the proper traffic barrier used on the bridge project.
3. The fence layout will indicate the odd post spacing and number of 8 ft. spaces.
4. The Limits of Pay Quantity for "Pedestrian Railing *(Chain-link Type)*" will equal the sum of the dimensions shown for the fence.
5. The expansion gap distance should be shown in the "Expansion Joint or Splice Detail" when required. This information should be placed with the note for intermediate splice dimensions.

Payment

Measurement will be indicated on the plans as the distance between the outermost CL of the fence posts *(1 1/4" diameter pipe),* measured along the CL fence *(as shown on the base sheet).* If fences of different lengths are required on the same bridge, the pay quantity should indicate the different lengths on the base sheet. The total fence length required for the bridge project will be shown in the bridge "Quantities" on the front sheet.

8'-3" high chain-link fence, which includes 5 ft. high-end sections, will be paid for using the standard pay item number 6404.00, "Pedestrian Rail *(Chain-link Type)".*

5 ft. high chain-link fence will be paid for using the standard pay item number 6404.02, "Pedestrian Rail *(Chain-link Type)".*

Chapter 4
Bridge Substructure

SECTION 401: GENERAL SUBSTRUCTURE DESIGN

401.01 – Geology Sheet Policy

Plans shall provide at least one sheet for the purpose of showing soil profile, pile layout, and pile design information.

General Items

- Standard notes for bearing piles and sheets piles.
- Notes specified by the Geotechnical Engineer.
- Standard Plan notes for concrete sheet piles or prestressed piling.
- Steel pile splice details, see Bearing Pile Policy.

Pile Data Tables

The following CAD cells shall be used by the Geotechnical Engineer and designers to specify the pile driving and pile data information on the geology sheet.

Pile Data							
Location	**Pile Number**	**Cut-Off Elevation**	**Minimum Penetration Below Cut-Off (Feet)**	**Pile Order Length (Feet)**	**Design Pile Bearing (Tons/Pile)**	**Pile Type**	**AC = PILDAT**

Pile Driving Data							
Location	**Pile Type**	**Cut-Off Elevation**	**Average Bearing Based on Current Formula (Tons/Pile)**	**Hammer Type**	**Ram Weight (Lbs)**	**Average Fall of Ram (Feet)**	**AC = PILOLD**

Elevation View of the Soil Profile

- The lengths of bearing piles must be shown to scale. The soil profile should show the type of soil at the tip of the pile, if the data is available.
- Station and elevation at the supports and CL bridge.
- Soil boring log: water table, blow counts, soil type.
- Show any MSE wall offsets, see MSE Wall Policy.
- Show and label Natural Ground profile.

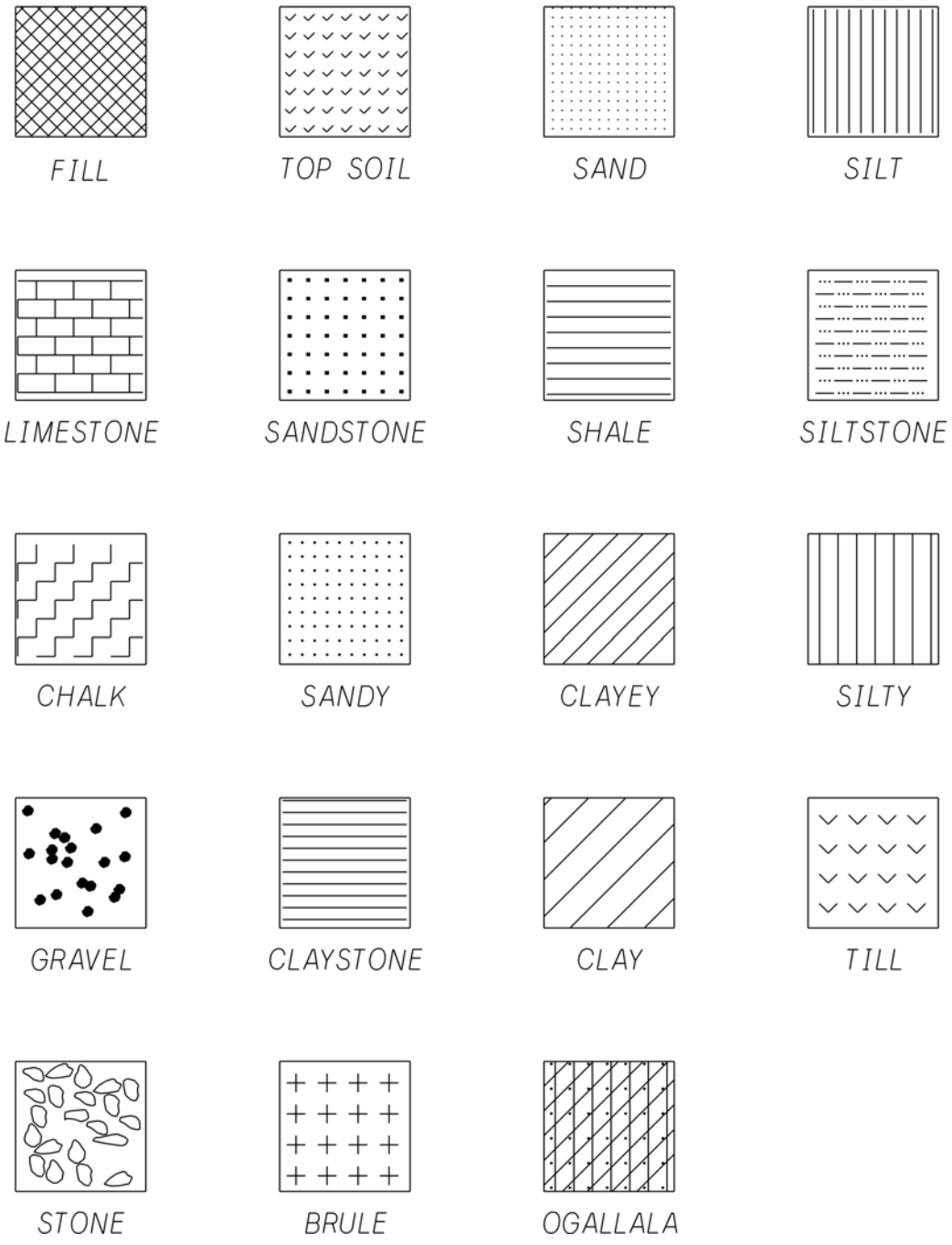
Bridge Pile Layout

The pile layout must contain all the geometrics to drive piling without referencing to other sheets. This includes but is not limited to the following information:

- North arrow
- Direction of flow *(stream crossings).*
- Skew at each support.
- Soil borings numbered, offset from CL roadway, and station.
- CL of supports, wings, sheet piling, railroads, utilities, and temporary shoring.
- Stations at CL roadway for supports and railroads.
- Base line layout for curved structures.
- Show but do not dimension existing piling.
- Limits of phased construction for substructure.
- Span dimensions.
- Interior and overall pile dimensions.
- Numbered piling at supports that indicate batter when required.
- For MSE walls, indicate CMP sleeve (Typ.), see MSE Wall Policy.
- Sheet pile layout:
  Overall length along CL.
  Offset dimension from CL roadway, abutments, and wings.

Soil Profile

For uniformity purposes, the following soils symbols, available in AC=GEOSYM in the Geology Library, should be used to represent the different types of soils on the soil boring logs.



AC = GEOSYM

401.02 - Bearing Piles Policy

Ground Vibration Pile Driving Procedures

It is possible that ground vibration, due to pile driving, could damage building structures located too close to the pile driving location. Potential damages due to pile driving other than structural ones, must be studied and dealt with based on the nature of the damage. The Bridge Division has adopted the following three procedures to eliminate the possibility of structural damages.

1. Pile driving should not damage any structure located 40 ft. or more from the pile driving location. No special precautions will be taken.
2. When driving pile 20 to 40 ft away from any structure, each pile must be driven inside a predrilled hole. The bottom elevation of the predrilled hole should be at least 2 ft below the elevation of the structure's footings.
3. If any structure is within 20 ft of the pile driving location, special precautions must be taken. Depending on the potential and the nature of the damage, each case must be studied individually.

General Design Criteria

Bridge bearing piles will use Allowable Stress Design to design pile layouts. The Geotechnical Engineer will determine the type of piling and allowable design tonnage for each bridge project. The maximum pile spacing for a given design tonnage is 10 ft.

Soil Parameters

The following design assumptions may be used with engineering judgment when more specific soil design information is not available.

* Allowable lateral pile load:

10" HP, and Concrete Type I	=	5 kips
12" HP or pipe, and 14" Concrete	=	7 kips
14" HP	=	9 kips

Pile Data Tables

The standard Pile Data Tables used by the Bridge Division are shown in the Geology Sheet Policy.

Cut-off Elevations

Pile cut-off elevations must be specified for each pile. Cut-off elevations may be grouped in the Pile Data Table for piling that have a common cut-off elevation. Implied elevations such as, "varies uniformly" must not be used.

Battered Piles

The pile dead load horizontal component is the only contribution from the batter that may be added to the **allowable** lateral pile load. The battered pile slope must be stated in a note on the Geological Sheet and preferably shown on the abutment or pier sheets. Acceptable pile batters are: 1:4, 1:5, 1:6, 1:7, 1:8 *(run:rise)*; see Definition of Bridge Terms for slope.

Pile Numbering

Piles must be numbered *(battered piling with a preceding "B"),* for each support location in the Pile Data Table and in the pile layout on the Geological Sheet.

Standard Notes

The appropriate standard notes published in Chapter 2, see Bearing/Sheet Pile Notes, must be shown on the Geological Sheet.

Piles for Integral Abutments

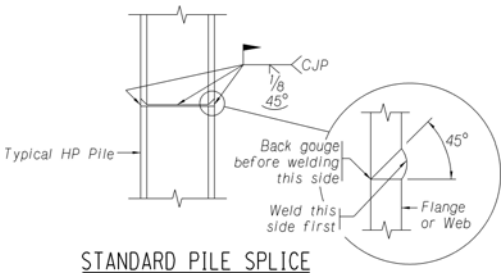
Since there is no universally accepted pile orientation for steel H piles used in integral abutments, Bridge Division policy is to have the piles oriented such that the web of the pile is parallel to the abutment CL. Pipe piles may also be used for integral abutments.

Integral abutment shall not be used for bridges with a skew angle greater than 30°.

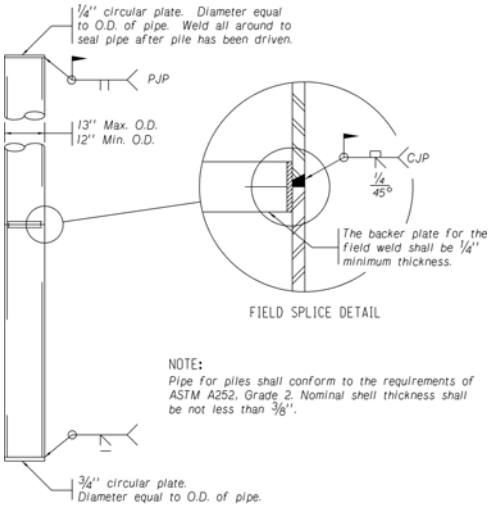
All piles designed for integral type abutments shall be predrilled unless waived by the Geotechnical Engineer.

Designers must provide standard note **#550** on the Geological sheet. The predrilled hole depth shall be determined by the Geotechnical Engineer.

Wings for integral abutments will be connected with tie rod(s) capable of resisting lateral earth pressure. Designers shall take into consideration wing pile(s) lateral resistance when calculating forces acting on the wing. Standard Note #341 must be shown on the front sheet when integral abutments are used. Wing piles will be embedded 2/3 the wing height into the wing pile encasement.



STANDARD PILE SPLICE



FIELD SPLICE DETAIL

PIPE PILE DETAIL

Steel Pile Splice Details

The CAD cells **STPILE** or **PILEP** must be shown on the Geological sheet when steel piling is specified. **STPILE** shows the standard H pile splice. **PILEP** shows a pipe pile splice.

Pile Data						
Location	Pile Number	Cut-Off Elevation	Minimum Penetration Below Cut-Off (Feet)	Pile Order Length (Feet)	Design Pile Bearing	Pile Type

AC = TPILE

Test Piles

Occasionally test piles will be specified by the Geotechnical Engineer to verify the design tonnage and length of the piling. The Geotechnical Engineer will specify which piles are to be the test piles and the designer must specify these piles in the Test Pile Data table, (AC=PILTES). In addition, the Pile Data table AC=TPILE will be used to specify the tentative pile order lengths to calculate the quantities.

Test Pile Data				
Location	Pile No.	Cut-off Elevation	Pile Order Length (Feet)	Design Pile Bearing (Tons/Pile)

Payment

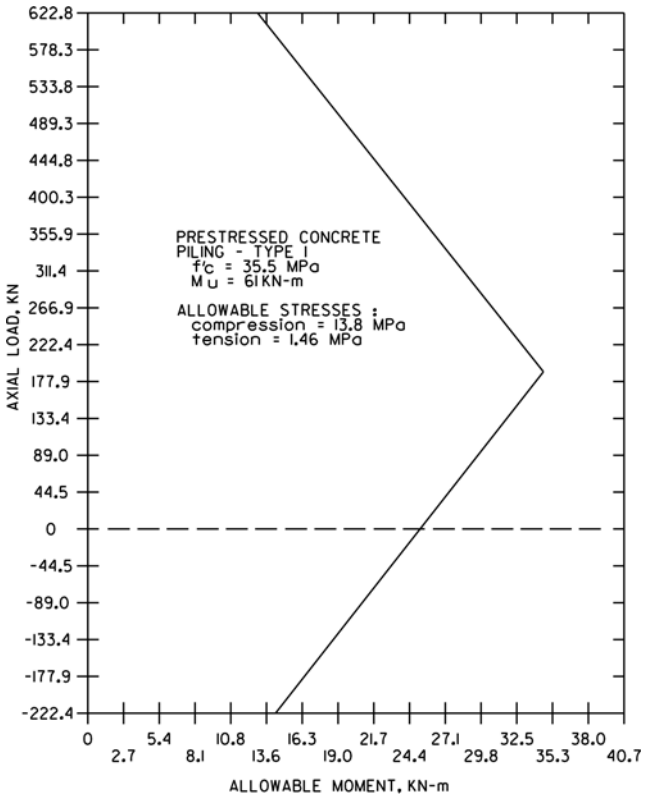
The quantities for bearing piles will be the total length (ft) of pile shown on the Plans. Payment for bearing piles shall be as stated in the Standard Specifications for Highway Construction. See Pay Items in Chapter 2 for standard pay item note that must be shown on the Front Sheet. Pay items not published in Chapter 2 should be verified with the Geological Section before they are used in the Plans.

Prestressed Concrete Piles

Prestressed concrete piles shall be shown in the Plans by including the concrete pile base sheets, see Chapter 6 *(2 sheets).* This may be treated as a Special Plan 1C and used for several bridges on one project or incorporated into the Bridge Plans as two regular sheets.

Standard Note #015 shall be shown in the General Notes on the Cover Sheet. This note tells where the concrete pile sheets can be found. Standard note #531 shall be shown on the Geology Sheet to specify the type of concrete piles used in the bridge.

If Cast-in-Place piles are specified, standard note #532 must be shown on the Geology Sheet and the dimensions A, B, and C will be provided by the Geology Section.



Moment Capacity (Type I)

The graph shown above may be used as a design aid to determine the moment capacity of Type I prestressed piles.

Steel HP plies

HP 12 X 53 piles shall be the minimum size used for HP bearing piles.

Steel Pipe Piles

All exposed pipe piles shall be filled with concrete. This concrete shall be Class “47B” with a minimum 28 day compressive strength of 3000 psi. This concrete shall be subsidiary to the pay item “Pipe Piling”.

401.03 – Tie Rod Policy

Design Criteria

- Tie rods shall be used, if needed, to tie abutment wing walls or the anchor block to the abutment.
- Forces in tie rods shall be computed using any applicable earth pressure distributions and any other horizontal forces acting on the wing wall or the abutment.
- The allowable axial tension in the tie rod shall not exceed 20 ksi.
- A standard upset tie rod detail shall be shown in the bridge plans.
- The entire tie rod shall be allowed to be of the upset size as an alternate design.
- Tie rods shall conform to ASTM A709/A709M, Grade 36 steel and standard note #401 must be included with the general notes on the Cover Sheet of the Plans.

The following table of tie rod information is based on the AASHTO 16th Edition, Section 10.26, and should be used to specify tie rods. Designers should be aware of the standard lengths available when specifying the overall length of the tie rod.

Tie Rod Information						Upset and Turnbuckle Information	
d (in)	Gross Area (in^2)	Weight/ft (L	D (in)	H (in)	J (in)	d (in)	Weight of 6" Turnbuckle
♦ 3/4"	0.442	1.503	4½"	8¼"	6"	1"	2.60
♦ 7/8"	0.601	2.046	5¼"	9 5/8"	7"	1 1/8"	2.72
♦ 1"	0.785	2.673	6"	11"	8"	1¼"	3.58
♦ 1 1/8"	0.994	3.382	9"	1'-2¾"	10 1/8"	1½"	5.50
♦ 1¼"	1.227	4.176	10"	1'-4 3/8"	11¼"	1¾"	9.50
♦ 1 3/8"	1.485	5.053	11"	1'-6"	1'-0 3/8"	1¾"	9.50
■ 1½"	1.767	6.013	1'-3"	1'-10 7/8"	1'-3"	2"	11.50
■ 1 5/8"	2.074	7.067	1'-4¼"	2'-0 7/8"	1'-4¼"	2"	11.50
■ 1¾"	2.405	8.185	1'-5½"	2'-2¾"	1'-5½"	2¼"	18.00
■ 1 7/8"	2.761	9.396	1'-6¾"	2'-4 5/8"	1'-6¾"	2½"	23.25
■ 2"	3.142	10.690	1'-8"	2'-6½"	1'-8"	2½"	23.25
■ 2¼"	3.976	13.530	1'-10½"	2'-10 3/8"	1'-10½"	2¾"	31.50
■ 2½"	4.909	16.703	2'-1"	3'-2¼"	2'-1"	3"	39.50
■ 2¾"	5.940	20.211	2'-3½"	3'-6"	2'-3½"	3½"	60.50

♦ Available in 40 ft. length.

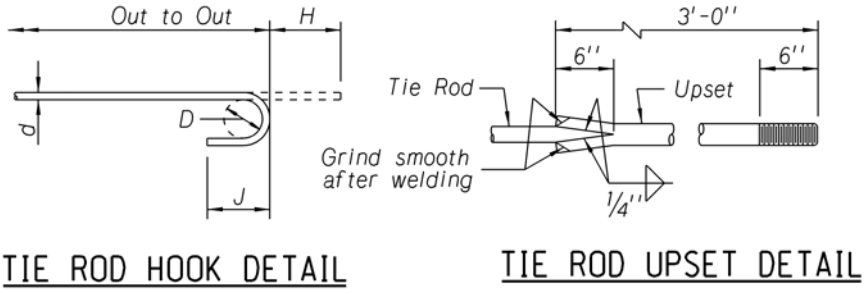
■ Available in 20 ft. length

Payment

Tie rods will be paid for under the pay item Structural Steel for Substructure. There will be no change in payment for alternate designs.

Standard Cell

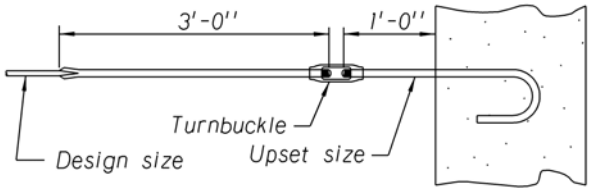
The following cell, AC=TIEROD, is available for detailing.



TIE ROD HOOK DETAIL

TIE ROD UPSET DETAIL

Note: As an alternate, the entire tie rod may be of the size shown for the upset.



DETAIL FOR TWO TURNBUCKLES

AC = TIEROD

401.04 - Excavation of Abutments and Bents

- The intent of this policy is to revise the method excavation quantities are calculated and paid.
- "Excavation for Bridges" at abutments and bents shall be paid for as Lump Sum. Pay items to be placed on the plans are as follows:

  Abutment No. 1 Excavation..... 1 Lump Sum

  Pier No. 1 Excavation *(or Bent)*..... 1 Lump Sum
  Pier No. 2 Excavation *(or Bent)*..... 1 Lump Sum
  Pier No. 3 Excavation *(or Bent)*..... 1 Lump Sum
  Abutment No. 2 Excavation..... 1 Lump Sum

- The "Additional Description" in the project estimate (BAMS) will include the following two items of information for the Bridge Division records:

  1. Approximate volumes of excavation for each pay item.
  2. The Geotechnical Engineer will provide "W" *(or "D")* to indicate wet *(or dry)* pier excavations.

- The following is a suggested format:

  Abutment XXX Cubic Yards D
  Pier XXX Cubic Yards W

- The estimates do not have to follow the rules provided in the Standard Specifications under "method of payment". This is not a quantity nor will it be represented on the plans, so do not spend a lot of time.
- A suggested estimate for the abutment volume is to use the volume provided by the granular backfill quantity.
- A suggested estimate for the pier or bent volume is to use simple overall dimensions. A bent for example: *(Overall roadway width + 3 feet)* x approximate soil height x *(concrete width + 3 feet).*
- Five (5) cubic yards can be used as a minimum for situations where minimal excavation is expected.

401.05 – Spread Footing Design Policy

The following procedures will be used in the design of a spread footing:

1. Obtain maximum allowable soil or bedrock design bearing pressure from the Geology Section.
2. Design footing based on geometrics and allowable pressure. Impact should be omitted.
3. Place the following note on the geology sheet:

   "Spread footing design based on xxx psf bearing.

Where xxx psf is the maximum bearing capacity as designed, not necessarily the maximum allowable.

401.06 – Substructure Concrete Policy

- Bridge components of the substructure shall have a minimum 28-day concrete strength of 3000 psi which is paid for by using the pay item “Class 47B-3000 Concrete for Bridges”.
- Under certain design considerations where economics warrant a higher concrete strength *(such as pier columns, pier caps, etc.),* designers may consider the use of 4000 psi concrete which is paid for by using the pay item “Class 47BD-4000 Concrete for Bridges”.
- Quantities will be based on the volume of concrete shown in the plans.
- The volume of pipe or concrete piles should not be included in the volume of concrete for the substructure.

401.07 – Scour At Bridge Sites

General

The effects of scour at bridge sites shall be investigated for the following two conditions:

- Design Flood. This shall be the more severe of the 100-year flood event or from an overtopping flood of lesser recurrence interval.
- Check Flood. This shall be the more severe of the 500-year flood event or from an overtopping flood of lesser recurrence interval.

The effects of scour and the bridge design for the anticipated scour involves hydraulic, geotechnical and structural concerns. Therefore, the bridge designer will need to work closely with the Hydrology and Hydraulics Section and the Geotechnical Section in Materials and Research throughout the design process.

The bridge designer shall assess the substructure requirements for scour as early as possible in the final bridge design process and shall notify the Assistant Bridge Engineer or any foreseen problems.

Definitions

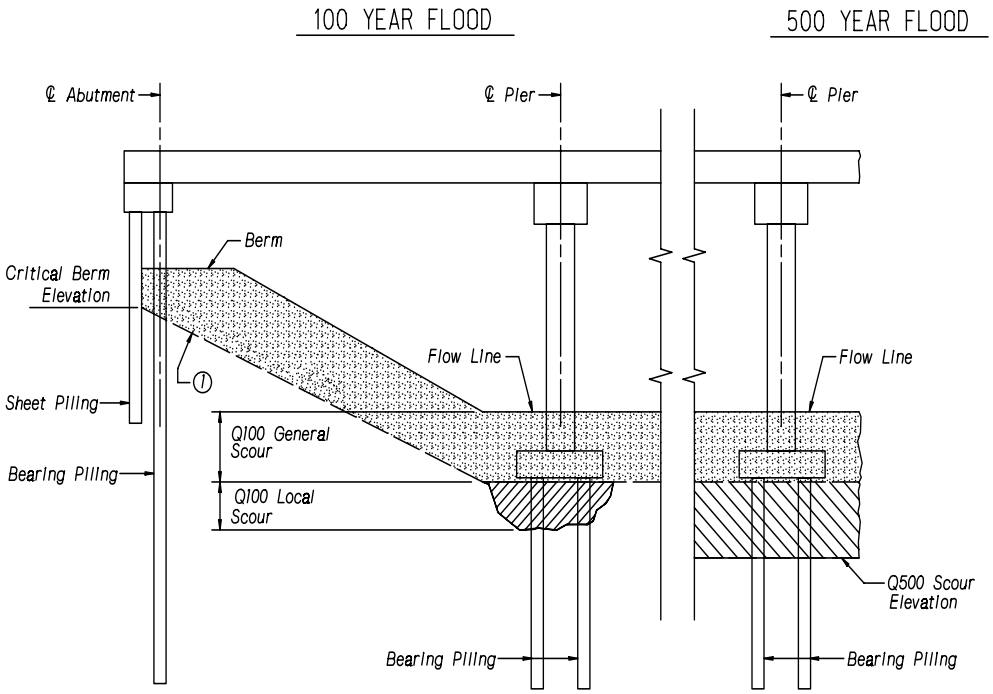
General Scour: Bridge scour that is not local scour. In a channel, general scour usually affects all or most of the channel width; i.e., general scour involves the removal of material from the bed across all or most of the width of a channel as a result of a natural flow contraction which causes increased velocities and bed shear stress.

Local Scour: Removal of material from the channel bed or banks that is at a specific location. Bridge scour that is localized at a pier, abutment, or other obstruction to flow.

Berm: The horizontal portion of the graded channel profile immediately adjacent to the abutment.

Critical Berm Elevation: The elevation that the soil in front of the abutment is assumed to scour to for the 100-year flood event.

DESIGN GUIDELINES FOR SCOUR



① Assumed channel slope near abutments for scoured conditions: 1½ : 1 for cohesive soils
2 : 1 for sandy soils

100-Year Flood Design Guidelines

Bridge Loadings

The bridge should be fully functional while in a scoured condition for the appropriate AASHTO Group Load combinations when subjected to a 100-year flood or an overtopping flood of lesser recurrence. The bridge designers shall consult with the Hydrology and Hydraulics Section regarding the applicability of ice loads in the above loading combinations.

Piers/Bents

The Q100 General Scour and the Q100 Local Scour shall be added together for the total scour anticipated at the piers and bents. Buckling of the bearing piles shall be investigated based on the unsupported length of the piles resulting from the scour.

Abutments

Sheet Piles

The steel sheet piling shall be designed in accordance with the Steel Sheet Piling Policy in Section 404.01.

Bearing Piles

Buckling of bearing piles shall be investigated based on the unsupported length of the piles resulting from the scour.

Bearing Piles

Pile loads and the depth of scour for the 100-year flood shall be provided to the Geotechnical Section in the Materials and Research Division. This information shall be provided for all abutments, piers and bents.

500-Year Flood Design Guidelines

Bridge Loadings

When checking the effects of a 500-year flood, the bridge should survive the loading combinations as noted:

AASHTO Standard Specifications for Highway Bridges

Use Group VIII and IX load combinations when investigating this extreme event situation.

AASHTO LRFD Bridge Design Specifications

Use Extreme Event-II Limit State when investigating this extreme event situation.

The stability of the bridge foundation for this design case shall be maintained. Excess reserve beyond that required for stability under this condition is not necessary.

The bridge designers shall consult with the Hydrology and Hydraulics Section regarding the applicability of ice loads in the above loading combination.

Piers/Bents

Piers and bents shall be designed for the Q500 Scour Elevation provided by the Hydraulics Section.

Abutments

Sheet Piles

The bridge designer shall provide sheet pile lengths that at least meet the minimum sheet pile tip elevation specified by the Hydrology and Hydraulics Section.

Bearing Piles

Pile loads and the depth of scour for the 500-year flood shall be provided to the Geotechnical Section in the Materials and Research Division. This information shall be provided for the piers and bents.

SECTION 402: ABUTMENTS

402.01 – Abutment Policy

General

It is the Bridge Division policy to use steel sheet piles with bearing piles in abutment cap for water crossing bridges.

Steel sheet piles need not be used in the following:

- Integral abutments.
- Abutments for bridges over railroads or highways.

Integral Abutments

Integral abutments are designed to allow horizontal movements and are rigidly attached to the superstructure. The Bridge Division policy is to support integral abutments on steel H piles. All piles for integral abutments, excluding wing piles, shall be placed in predrilled holes to elevation determined by the Geotechnical Engineer. Pile orientation and backfilling shall conform to Piles for Integral Abutments Policy *(see 401.02, Page 172).*

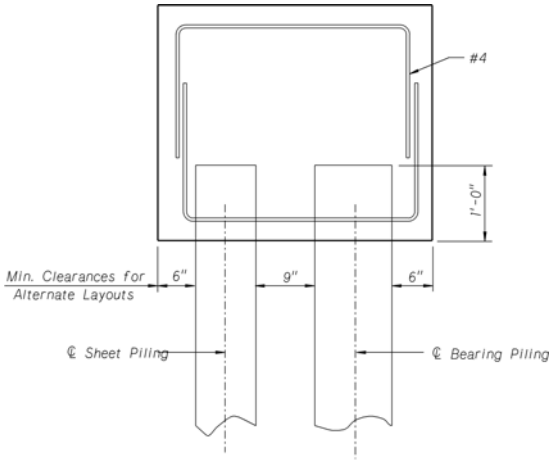
Anchor Blocks

If the abutment design requires an anchor block, it should be designed for a 1.5 minimum Factor of Safety against overturning, and placed beyond the grade beam and below the paving section. Tie rods connecting the anchor block to the abutment should be placed below the grade beam.

Sheet Pile Abutment Cap Geometry

In order to accommodate various sheet pile depths without changing the geometry and reinforcing steel of the abutment cap, designers must provide a cap reinforcing detail similar to the one shown below.

Abutment plans shall include a field note to provide holes in sheet piling for the stirrup bars.



ABUTMENT CAP DETAIL

Widening

New concrete and piling should be laid out and dimensioned from the CL roadway and not from any existing concrete or piling, due to the fact that these items were seldom built precisely according to the As-Built plan.

402.02 – Abutment Drainage Policy

General Design

All bridge designs shall allow for drainage behind abutments with either a drainage system or weep holes.

Bridge Widenings

On existing bridges, drainage matting should be provided only if there is extensive excavation.

Subsurface Drainage Matting

Drainage matting should be shown as constant depth piece of matting. It will wrap around a sloping drain pipe at the bottom and extend 3 ft. along the wing at the ends. Pipe layouts and drainage matting should preferably be shown in the elevation view on the abutment sheets. Note #602 shall be included on the drainage detail sheet.

Weep Holes

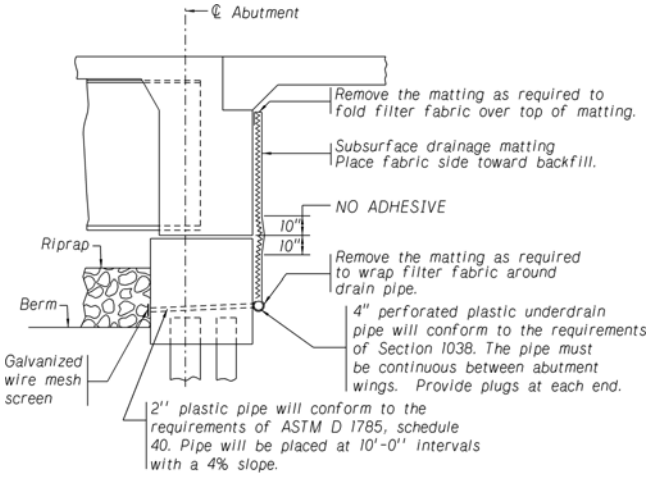
Weep holes should be one inch minimum diameter and provided at approximately 10 ft intervals along the abutment, or between piling would be sufficient. Weep holes should be extended to daylight or into the rock riprap and be covered with a galvanized wire mesh screen.

Payment

The pay item Subsurface Drainage Matting shall be measured by the square yard and includes payment for furnishing and placing of PVC pipe, wire mesh and all miscellaneous items required for placement of the drainage matting.

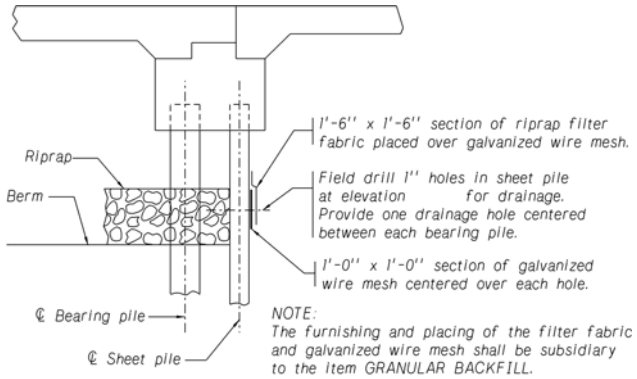
CAD Cells

The CAD cells shown here are available for detailers.



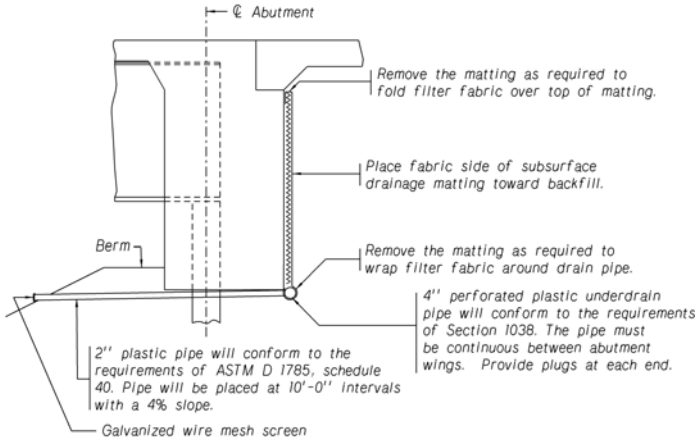
DRAINAGE DETAIL

AC=MAT1



DRAINAGE DETAIL

AC=MAT2



DRAINAGE DETAIL

AC=MAT3

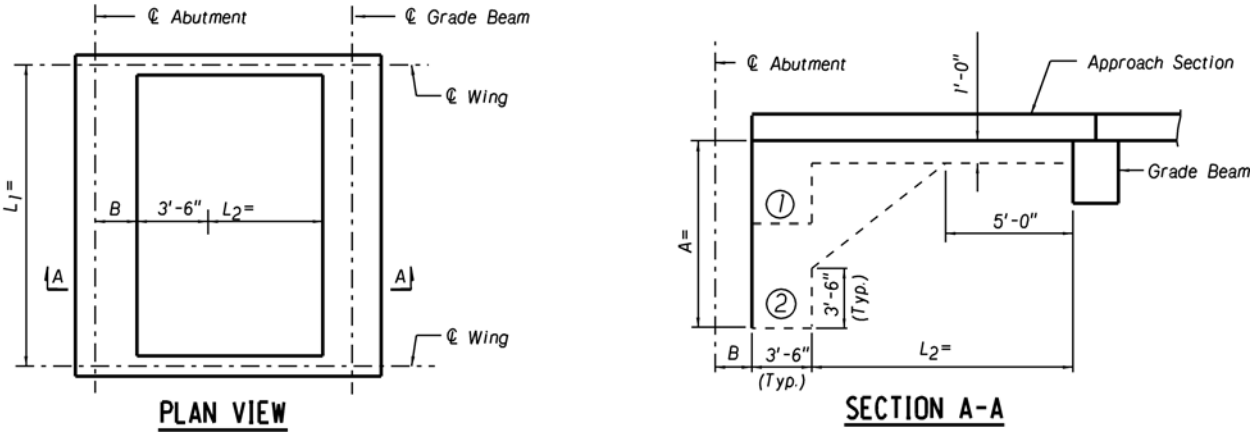
402.03 – Granular Backfill Policy

The interior of abutments and wing walls, tie rod trenches, and the area beneath approach slab sections, as excavated by the contractor, shall be backfilled with granular backfill. See Section 702 Excavation of Structures in the NDOR Standard Specifications.

Payment

The pay item on the Front Sheet will be Granular Backfill *(cu. yd.)*. The Bridge Division has determined that the Granular Backfill quantity shall be measured using a simplified X-sectional area shown below, and calculated using the equation: Quantity *(cu. yd.)* = Area [L_1 + 2 (L_2)]. The plans must include a Granular Backfill Detail consisting of a Plan View, an appropriate Section *(1 or 2),* see Section A-A below, and the following note:

> The pay quantity for granular backfill *(per abutment)* has been established using the following equation:
>
> Quantity = AREA x [L_1 + (2 x L_2)]/27 Cu.Yd.



Quantity Definitions

L_1 = The horizontal distance between CL wings measured along the CL of abutment in Ft.

L_2 = The horizontal distance perpendicular to CL of abutment from the back face of abutment to the front face of grade beam in Ft., minus 3'-6".

A = The vertical distance from the bottom of the approach slab to the bottom of the abutment or drainage matting *(whichever is lower),* at CL of roadway.

AREA = The cross sectional area of granular backfill, normal to CL roadway.

(1) = AREA typical for shallow abutments.

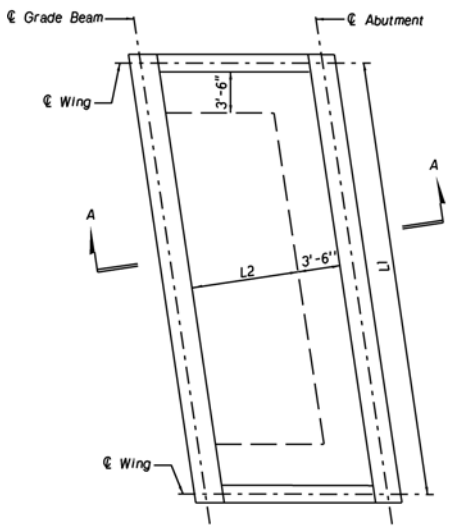
(2) = AREA typical for deeper abutments.

Detailing

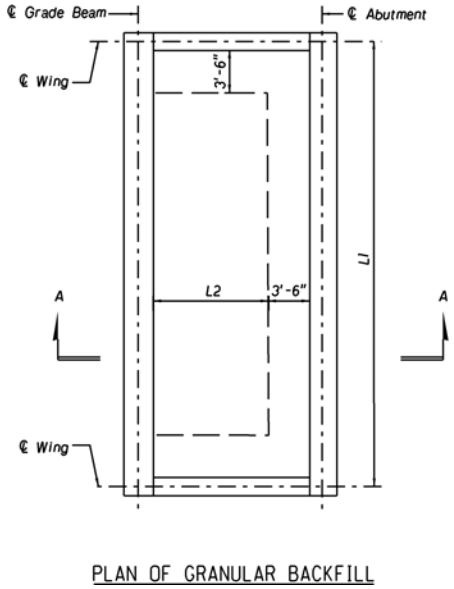
Plan details must provide all dimensions necessary to calculate the established volume for the quantity. The volume detailed must be clearly shown, but will not accurately describe the quantity required.

The following cells are recommended to indicate a Plan View and Section for a shallow abutment or a deep abutment:

Shallow Abutment

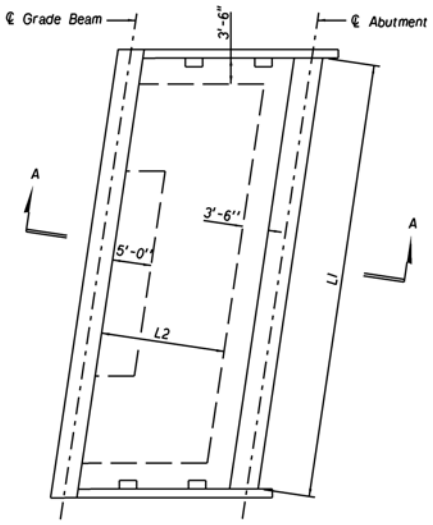


PLAN OF GRANULAR BACKFILL

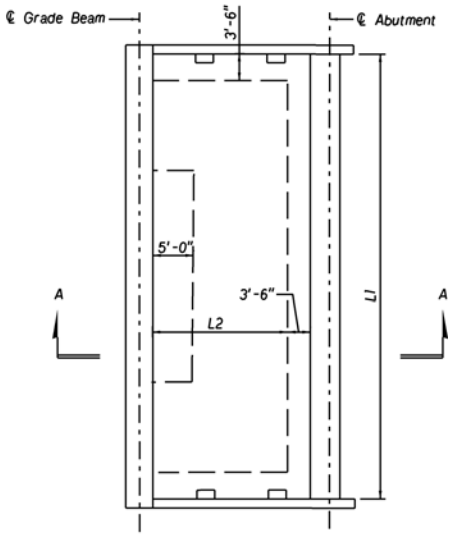


PLAN OF GRANULAR BACKFILL

Deep Abutment

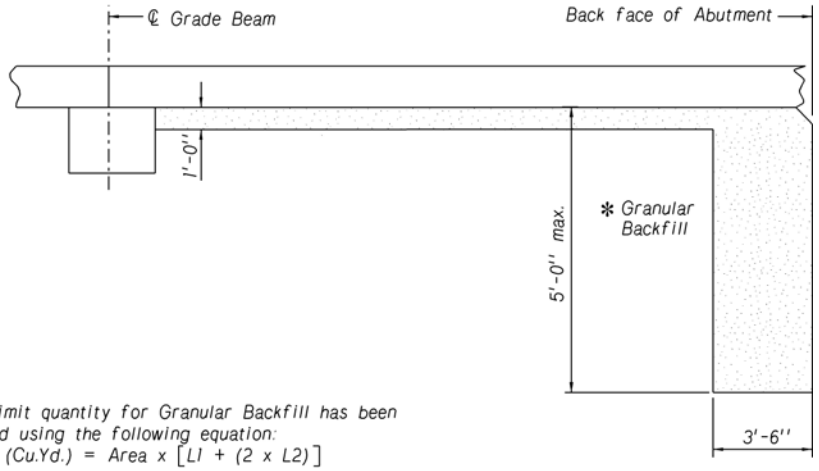


PLAN OF GRANULAR BACKFILL



PLAN OF GRANULAR BACKFILL

Shallow Abutment

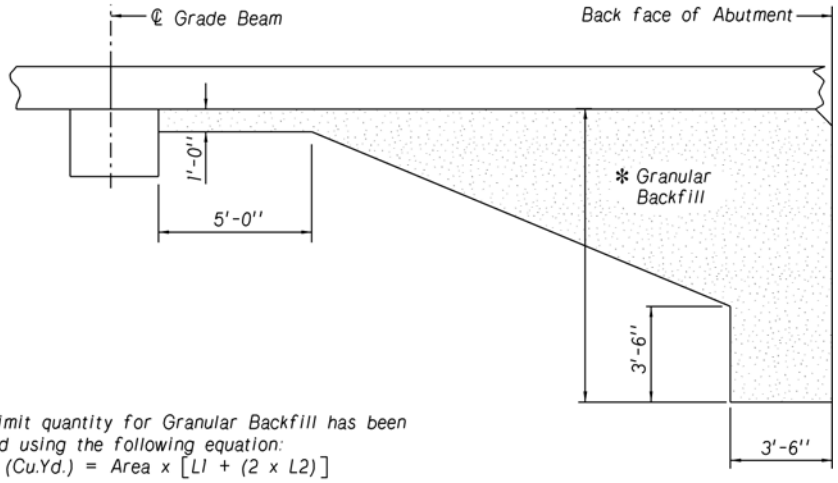


The pay limit quantity for Granular Backfill has been established using the following equation:
Quantity (Cu.Yd.) = Area x [L1 + (2 x L2)]

* *The Granular Backfill in this area shall be placed in 8 inch layers and compacted by a single pass of a lightweight mechanical tamper, roller, or vibratory compactor. There is no density requirement. Heavy compaction equipment shall not be used in this area. Flooding the granular backfill with water is not allowed.*

SECTION A-A

Deep Abutment



The pay limit quantity for Granular Backfill has been established using the following equation:
Quantity (Cu.Yd.) = Area x [L1 + (2 x L2)]

* *The Granular Backfill in this area shall be placed in 8 inch layers and compacted by a single pass of a lightweight mechanical tamper, roller, or vibratory compactor. There is no density requirement. Heavy compaction equipment shall not be used in this area. Flooding the granular backfill with water is not allowed.*

SECTION A-A

402.04 – Grade Beam Policy

General Design

Grade beams will be required on projects that specify new approach slabs. Station and elevation at grade for the grade beam CL should be shown on the front sheet Plan and Elevation views. Any roadway grade transitions during construction should be made in the paving section.

Grade Beam Layout

CL grade beams shall be parallel to the abutment and located 20 ft. beyond the end of the bridge floor. Grade beams shall extend to the outside edges of the approach section; an exception would be sidewalk layouts. If wings extend beyond the grade beam, changing paving section layouts is not recommended; see the wing policy for more information.

Plans should indicate a grade beam design of constant section and approach slab haunch. As an alternate, the designer may provide a variable haunch in the approach slab.

Grade Beam Piles

Piling will be used to support all grade beams. Grade beam pile layouts shall be included on the geology sheet with the abutment piling.

For abutments utilizing Mechanically Stabilized Earth (MSE) walls, designers should lay out grade beam piles directly behind abutment piles. This means if you drew a line perpendicular to the CL abutment passing through the abutment piles, the grade beam piles would also fall on this line.

Reinforcement Layout

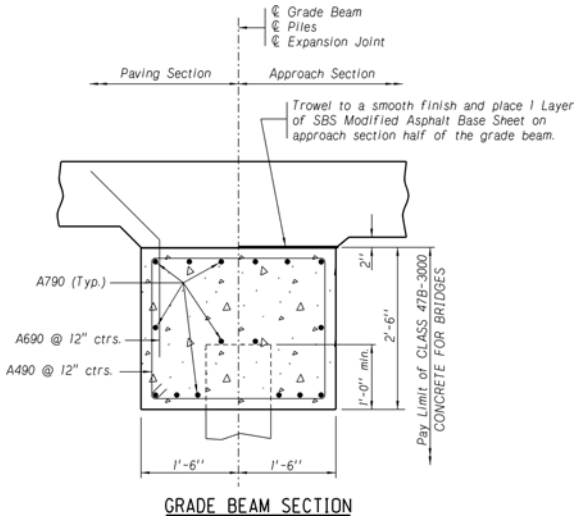
#4 closed stirrup bars should be parallel to CL Roadway to avoid unnecessary bar marks and detailing. #7 bars were adopted for use as beam reinforcement using conservative estimates for live load impact and pavement section reactions. The grade beam details shown in the cell (AC=GBEAM), allow for a pile spacing of 10 ft. measured along the CL grade beam.

Payment

Concrete and steel in the grade beam shall be included in the abutment pay items “Class 47B-3000 Concrete for Bridges” and “Epoxy Coated Reinforcing Steel”. Grade beam piling shall be considered abutment piling for the purpose of payment.

Grade Beam Detailing

Grade beam detail information should be located with the abutment information. The cell shown (AC=GBEAM), is available for use with the abutment details.

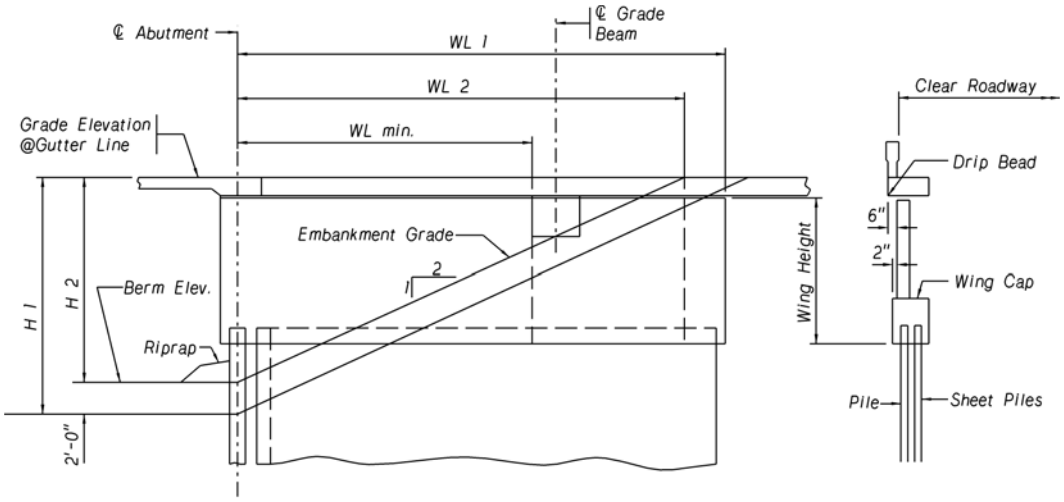


GRADE BEAM SECTION

402.05 – Wing Policy

Design Criteria

- Wing walls shall be supported by piles, sheet piles *(on stream crossings)* and, if necessary, tie rods.
- Minimum wing wall thickness shall be 14” to accommodate chutes and pump hoses when pouring concrete.
- Wing walls shall be designed to resist soil pressure. Wing walls shall be designed such that they do not deflect laterally beyond the allowed ½” tolerance under backfill pressure in extreme scour conditions.
- Wing walls shall be designed taking into account tie rod(s) forces and piles lateral resistance.
- Wing walls shall not be attached to the grade beam.



WING LAYOUT SKETCH

- Wing Layout

  In general, U-shaped wing length (WL_{min}, $WL_{(1,2)}$) shall be determined by the following:

  WL_{min} = Wing length from abutment CL to the front face of the grade beam.

  In this case, the gap between the wing wall and the grade beam shall be 1” and should be indicated on the plans as “1” preformed joint filler”.

  $WL_{(1,2)} = (H_{(1,2)}/\text{slope} / \text{Cos. (skew)} \pm (1'\text{-}0”)$.

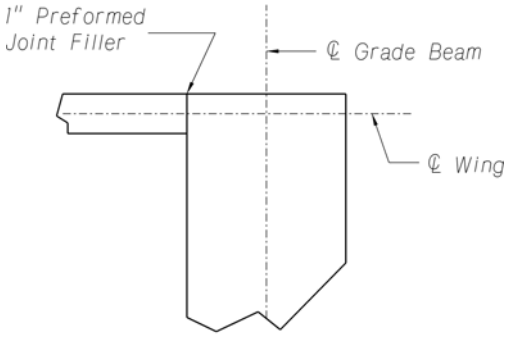
  H1 = Height definition to be used when the berm is not protected and the bridge is located over a waterway.

  H2 = Height definition to be used when the berm is protected by riprap or concrete slope protection, or the bridge is not located over waterway.

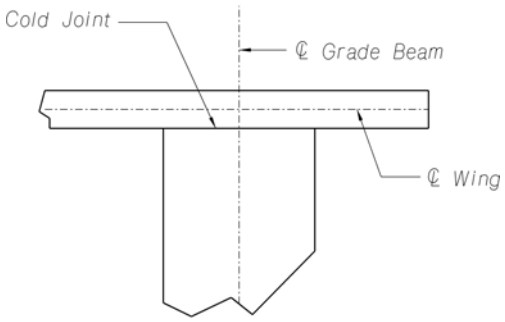
  Slope = The ratio *(rise/run)* of the embankment perpendicular to the skew.

- The exterior face of the wings shall be 6” inward from the outside edge of the approach section, see Wing Layout sketch. Designers should be sure that wing location does not interfere with placement of the girders at the abutment.

- Wing walls shall be placed below the approach slab, with a 2 1/8” gap between the bottom of the approach and the top of the wing to allow for live load deflection. The gap should be indicated on the plans as a 1/8” hard board on top of 2” extruded polystyrene.
- When wing walls extend beyond the grade beam, the joint between the wing wall and the grade beam should be indicated on the plans as cold joint.
- When wing length extends beyond CL of grade beam, designers shall check both approach and pavement slab overhang for appropriate reinforcement due to guardrail attachment on unsupported slab edges.
- When wing length is greater than 7 ft. *(length of rail over pavement section)* beyond the CL of grade beam, the approach section should be lengthened and redesigned with Section Leader approval.



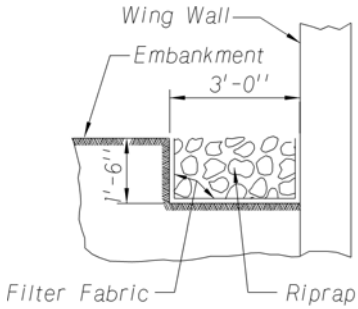
Wing ends at face of the Grade Beam



Wing extended beyond Grade Beam

Protection of Wings

All bridges shall have filter fabric and rock or broken concrete riprap placed along the wing where the wing is not protected by concrete slope protection. The riprap shall extend from the berm elevation to the face of end rail buttress *(see sketch below).* Riprap width shall be a minimum of 3 feet from the outside of the wing wall at a depth of 1’-6”. The CAD cell (AC+WNGRIP), shown at right, is available for designers.



NOTE: The average size of riprap shall be .25 cu. ft., or 35 lbs.

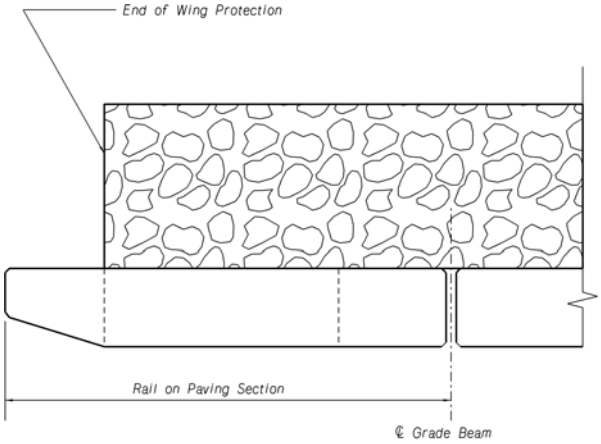
WING RIPRAP DETAIL

Bridge Base Sheets

Not available for abutment wings.

Quantities

Payment for concrete and reinforcement used in the wings shall be included with the pay items for the abutment.



Wing Protection

SECTION 403: PIERS/BENTS

403.01 – Pier and Bent Policy

General

- Open pile bents, encased pile bents, hammerhead piers, multi-column piers and wall piers are pier types that are being used by the hydraulic section of the Bridge Division.
- On stream crossings, pier/bent type and elevations shall be decided by the hydraulic section of the Bridge Division.
- The upstream and downstream sides of a solid wall pier or encased pile bent shall be battered and upstream side shall be protected with Nose Armor Angle.
- The minimum width of the top of a solid wall pier or encased pile bent if more than 2'-0" are needed for bearing seats.
- For grade separation, standard pier details shown in Page 189 and Page 190 can be used.
- The minimum width of any pier cap for grade separation structures shall be 3'-0".
- For aesthetic reason, it is recommended that the pier cap be 6" wider than the column *(3 overhang on each side of the column).*

Concrete

- Concrete for piers and bents shall conform to the BOPP manual Substructural Concrete Policy *(see Section 401.06, Page 178).*

Reinforcement

- All reinforcement bars used in piers and bents shall be

Pier Columns

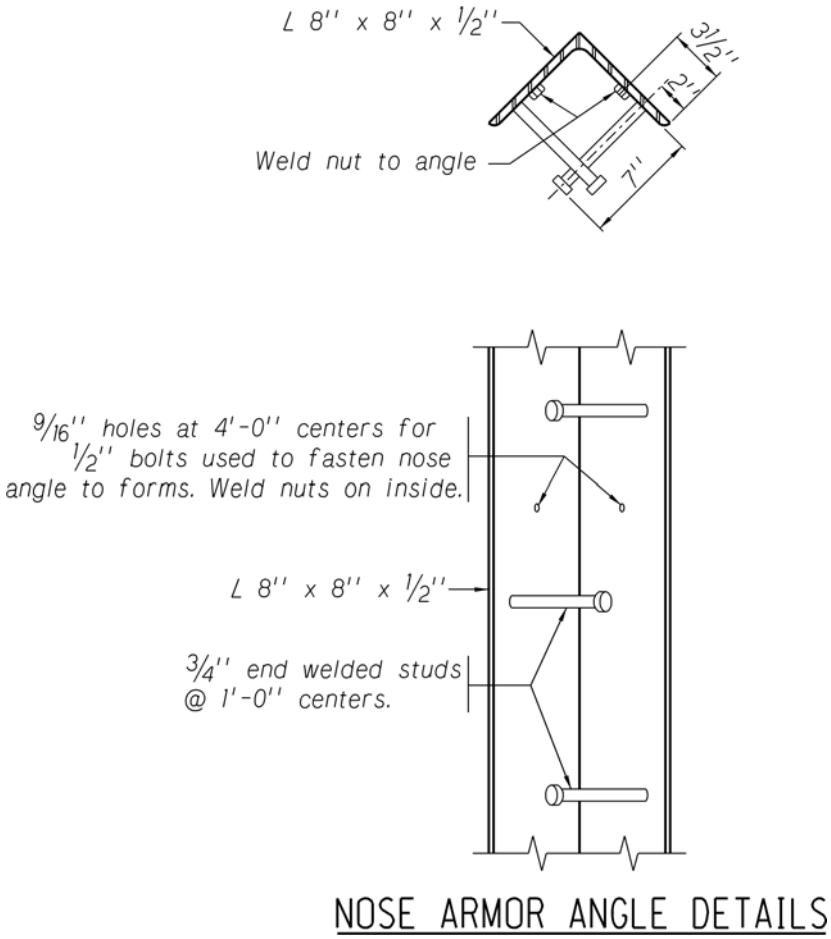
- The minimum recommended size of a square column is 2'-0".
- For rectangular columns wider than 4'-0", designers shall use crossties or overlapped ties to meet AASHTO requirements.
- Conforming to industry standards for circular column forms, column diameters must be specified in 6" increments. The Bridge Division has assumed a 2'-6" minimum column size and will specify columns as 2'-6", 3', 3'-6", 4', or 4'-6".

Pier Footings

- The minimum thickness of any footing supported on piles shall be 3 feet.
- For highway crossings, a minimum vertical distance of 3 feet shall be provided between ground elevation and the top of any pier footing.
- For railroad crossings, the minimum footing embedment shall conform to railroad requirements *(see Section 102.01, Page 11).*
- For water crossings, the hydraulic section shall determine pier footings elevations to provide adequate scour protection.

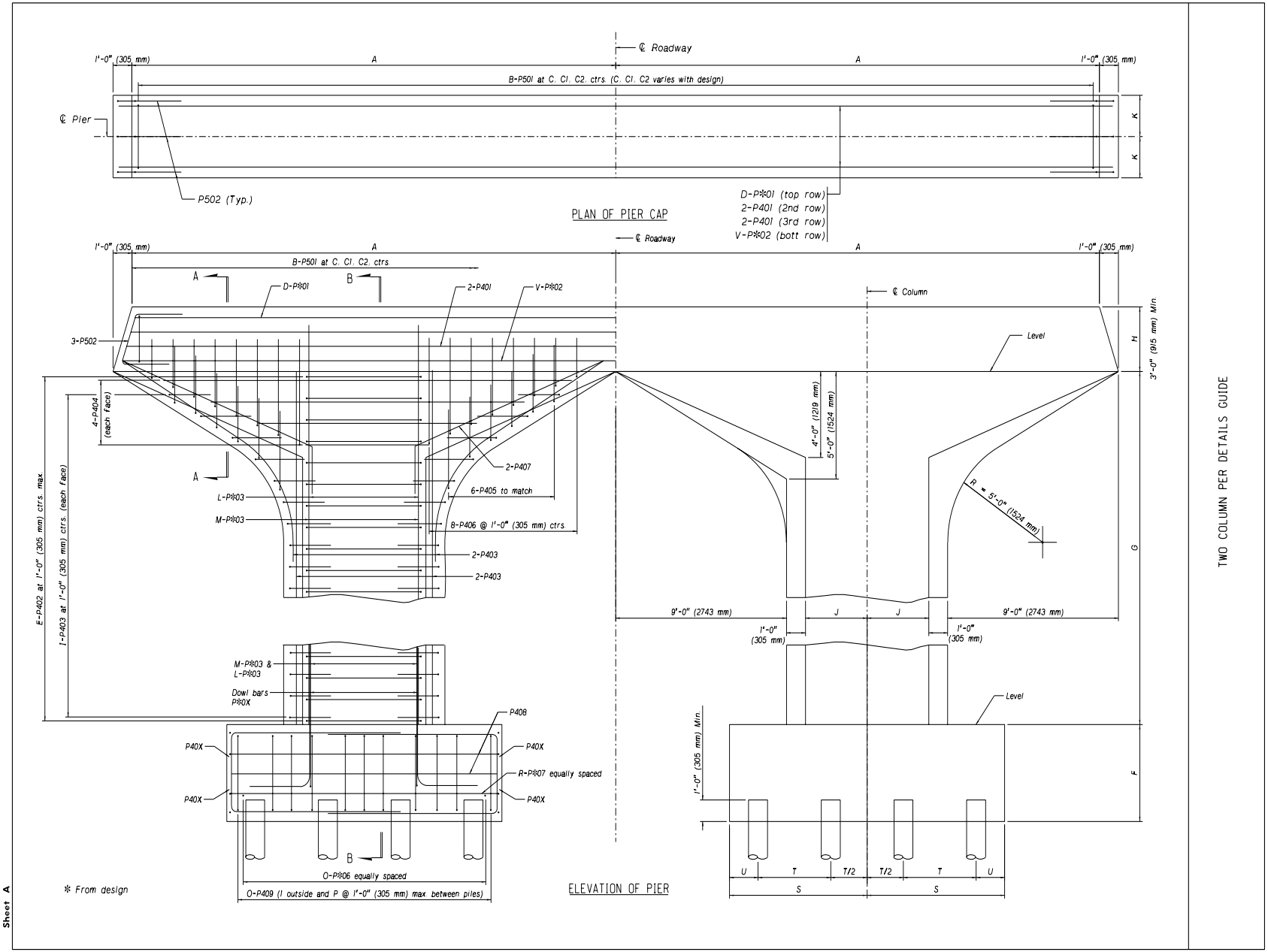
Nose Armor Angle Policy

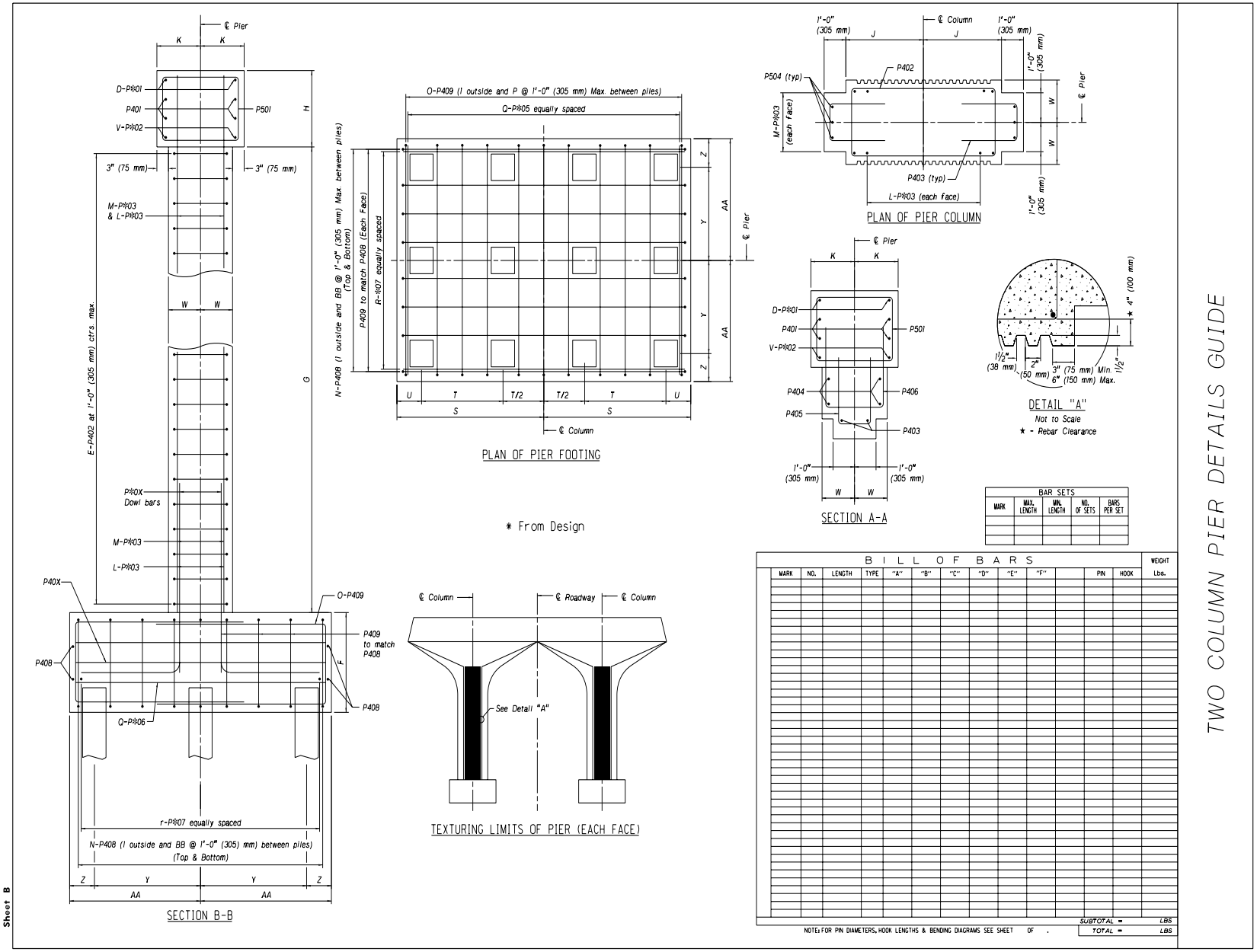
- Nose armor angles shall be provided at stream crossings for all concrete piers and bents.
- Nose armor angles will be placed on the upstream side only.
- If galvanized nose angles are required, note #402 shall be provided on the cover sheet.
- Designers should use the cell, NOSEAA shown below.



NOSE ARMOR ANGLE DETAILS

AC = NOSEAA


℄ Roadway
1'-0" (305 mm)
A
B-P50I at C. CI. C2. ctrs. (C. CI. C2 varies with design)
℄ Pier
P502 (Typ.)
K
D-P*01 (top row)
2-P401 (2nd row)
2-P401 (3rd row)
V-P*02 (bott row)
PLAN OF PIER CAP
B-P50I at C. CI. C2. ctrs
B
D-P*01
2-P401
V-P*02
3-P502
℄ Column
Level
H
3'-0" (915 mm) Min.
4-P404 (each face)
E-P402 at 1'-0" (305 mm) ctrs. max
I-P403 at 1'-0" (305 mm) ctrs. (each face)
2-P407
6-P405 to match
L-P*03
M-P*03
8-P406 @ 1'-0" (305 mm) ctrs.
2-P403
4'-0" (1219 mm)
5'-0" (1524 mm)
R = 5'-0" (1524 mm)
G
9'-0" (2743 mm)
J
1'-0" (305 mm)
M-P*03 & L-P*03
Dowl bars P*0X
P406
P40X
R-P*07 equally spaced
O-P*06 equally spaced
O-P409 (1 outside and P @ 1'-0" (305 mm) max between piles)
* From design
ELEVATION OF PIER
1'-0" (305 mm) Min.
F
U
T
T/2
S
TWO COLUMN PER DETAILS GUIDE
Sheet A


℄ Pier
K
K
D-P#01
P401
V-P#02
P501
H
3" (75 mm)
3" (75 mm)
M-P#03
& L-P#03
W
W
E-P402 at 1'-0" (305 mm) ctrs. max.
G
P#0X
Dowl bars
M-P#03
L-P#03
P40X
O-P409
P409
to match
P408
P408
F
P408
Q-P#06
r-P#07 equally spaced
N-P408 (1 outside and BB @ 1'-0" (305) mm) between piles)
(Top & Bottom)
Z
Y
Y
Z
AA
AA
SECTION B-B
O-P409 (1 outside and P @ 1'-0" (305 mm) Max. between piles)
Q-P#05 equally spaced
N-P408 (1 outside and BB @ 1'-0" (305 mm) Max. between piles)
(Top & Bottom)
P409 to match P408 (Each Face)
R-P#07 equally spaced
Z
Y
Y
Z
AA
AA
℄ Pier
U
T
T/2
T/2
T
U
S
S
℄ Column
PLAN OF PIER FOOTING
* From Design
℄ Column
℄ Roadway
℄ Column
See Detail "A"
TEXTURING LIMITS OF PIER (EACH FACE)
1'-0" (305 mm)
J
℄ Column
J
1'-0" (305 mm)
P504 (typ)
P402
1'-0" (305 mm)
M-P#03 (each face)
W
W
℄ Pier
P403 (typ)
L-P#03 (each face)
1'-0" (305 mm)
PLAN OF PIER COLUMN
℄ Pier
K
K
D-P#01
P401
V-P#02
P501
P404
P406
P405
P403
1'-0" (305 mm)
1'-0" (305 mm)
W
W
SECTION A-A
★ 4" (100 mm)
1½" (38 mm)
2" (50 mm)
3" (75 mm) Min
6" (150 mm) Max.
1½"
DETAIL "A"
Not to Scale
★ - Rebar Clearance
BAR SETS
MARK
MAX. LENGTH
MIN. LENGTH
NO. OF SETS
BARS PER SET
B I L L O F B A R S
WEIGHT
MARK
NO.
LENGTH
TYPE
"A"
"B"
"C"
"D"
"E"
"F"
PIN
HOOK
Lbs.
SUBTOTAL =
LBS
TOTAL =
LBS
NOTE: FOR PIN DIAMETERS, HOOK LENGTHS & BENDING DIAGRAMS SEE SHEET OF .
Sheet B
TWO COLUMN PIER DETAILS GUIDE

SECTION 404: SHEET PILING

404.01 – Steel Sheet Piling Policy

General Design Criteria

The following guidelines should be used when sheet piles are to retain fill behind abutments.

- **Design Length**

  The design length of the abutment sheet piles will be based on the critical berm elevation given in the bridge design data sheet, see Page 2 for Data Sheet Preparation Policy.

- **Lateral Earth Loads**

  Sheet piles should be designed for lateral earth loads and not designed to resist any vertical loading. Sheet Piles will be designed to maintain overall stability per Section 5.2.2.3 "Overall Stability" of the AASHTO Standard Specifications, 16th Edition and 1997 interim. Accordingly, a safety factor of 1.5 is suggested. This does not preclude justifiable exceptions based on sound engineering principles.

- **Fixed Abutments**

  On slab bridges and bridges where abutments are tied back to an anchor block, the connection at the abutment cap may be considered to be rotation free and translation fixed. On all other bridges, sheet piling should first be designed as a cantilever *(i.e., rotation fixed and translation free at the top and fixed at the bottom).* If the resulting section is not practical *(i.e., depth > 10"),* then anchor the abutment cap to an anchor block with tie rods.

- **Granular Soil**

Y_{sat}	=		Water table omitted from design
∅	=	25°	*(Friction angle)*
y	=	125 pcf	*(Unit weight)*
K_a	=	0.4	*(Coefficient of Active Earth Pressure)*
K_p	=	2.5	*(Coefficient of Passive Earth Pressure)*

The equivalent fluid density for these soil conditions shall be Y_{eq} = 50 Lb./Cu. Ft. and the basic earth pressure P *(psf)* can be calculated as:

$P = Y_{eq} Z$, where:

Z = Design well height (FT)

Sheet Pile Detailing

General steel sheet pile design criteria shall be provided in the plans using Standard Note #521. This information will be used by the Contractor to provide the pile section and layout shown in the Shop Plans. The following items must be provided in the Plans:

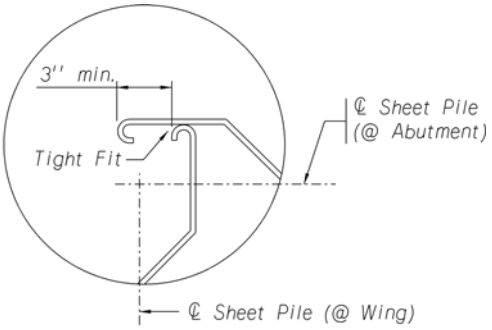
- General layout of sheet piles
- Minimum section length and section modulus/ft of the sheet pile that will be determined by design.
- Designers will specify a maximum section depth of 10" for designs that require up to 19.4 in^3 section modulus per foot of wall. Designers shall specify at least a 1'-0" section depth for designs that require more than 19.4 in^3 section modulus per foot of wall.

Sheet Pile Detailing *(continued)*

- Minimum thickness of 5/16".
- Minimum embedment of 9" into concrete.
- **Corners**

  Steel sheet pile shall be tight fit with a 3" minimum lap at the corners. The corner detail cell AC=SPCORN must be shown on the corner on the Geology Sheet. Bent or locked sheet pile should not be used for corner sheet piles. Bolted corners are not cost effective and will not be permitted at any time.

  If for some unusual reason bent corners are needed, the piling should be bent in lengths less than 10 ft. to allow for local fabrication. This may require more than one pile at the corner to reach the required elevation. Designers shall indicate the bent option criteria on the plans and refer to one of the current industry handbooks for detailing.



SHEET PILE CORNER DETAIL (TYP.)
Not To Scale

AC=SPCORN

- **Sheet Pile Detailing**

  The following guidelines should be used to show sheet piles on the geology sheet.

1. Sheet piling sections will not be detailed in the Plans.
2. Location of the CL sheet pile walls relative to the CL Roadway & CL Abutments.
3. Pay quantity length along the CL sheet pile wall.
4. Show corner detail cell *(see previous section).*
5. Standard Note #521 must be shown.

Note:

For common sheet pile sections, refer to one of the current industry handbooks.

404.02 – Concrete Sheet Pile Policy

General

- In general, concrete sheet piling shall not be specified in the Plans without permission from the Bridge Engineer.
- The English Standard Plan No. 610-R1 is the only sheet available for detailing the concrete piling. In metric projects, designers shall modify the Standard Plan, include it in the Bridge Plans as a Special Plan 2C and add the following note to the Geology Sheet:
- Prestressed concrete sheet piles shall conform to the Special Plan 2C and have a thickness of ____ mm.

Design Assumptions

Sheet pile is fixed at 2 ft. below scour and pinned in abutment cap. The unit weight of an equivalent fluid for soil pressure is 50 lb./cu.ft.

f'c = 3500 psi *(24 MPa)* for precast sheet piling

f'c = 5000 psi *(34.5 MPa)* for prestressed sheet piling

Moment

Moment Total = $C_1 W_1 + C_2 W_2$ *(ft-lbs/ft width)*
$W_1 = 50*A$ *(lbs/ft^2)* $W_2 = 50*H$ *(lbs/ft^2)*

Allowable Moment

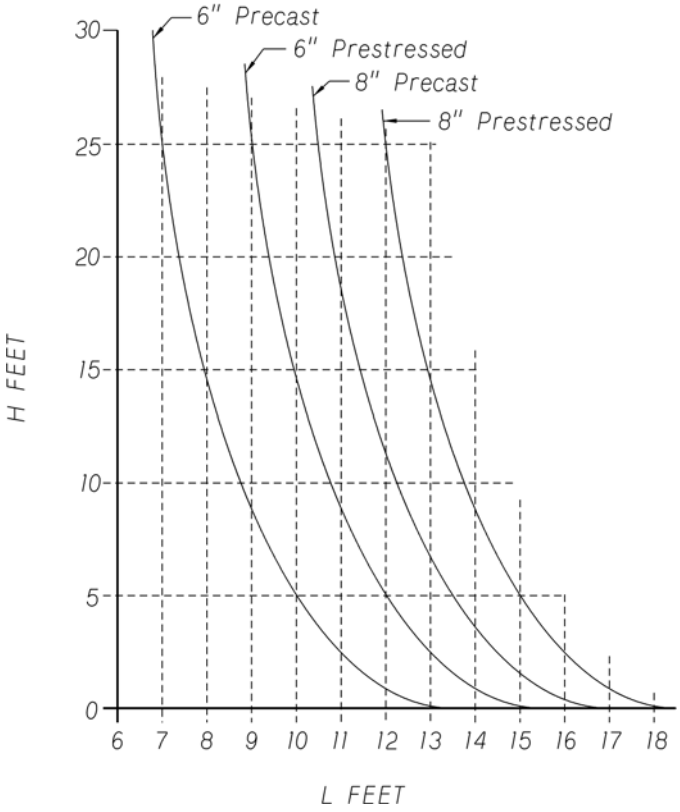
6" Precast Piling = 3.95 kft/ft Width
6" Prestressed Piling = 6.22 kft/ft Width
8" Precast Piling = 8.25 kft/ft Width
8" Prestressed Piling = 11.05 kft/ft Width

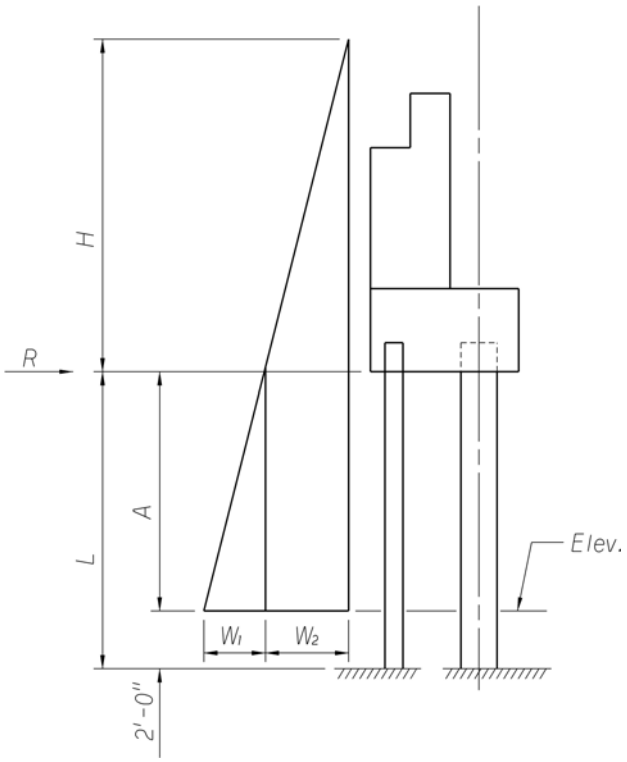
$$R = \frac{W_2 h}{2} + \frac{(3W_2+W_1)a^2}{6L} + \frac{(2W_2+W_1)\,a}{L}\,\frac{M}{L} \quad \text{(lbs)}$$

L	C_1	C_2
7.0	2.8912	4.6556
7.5	3.4149	5.5290
8.0	3.9750	6.4688
8.5	4.5710	7.4742
9.0	5.2025	8.5448
9.5	5.8691	9.6801
10.0	6.5707	10.8800
10.5	7.3069	12.1441
11.0	8.0777	13.4721
11.5	8.8828	14.8640
12.0	9.7222	16.3194
12.5	10.5958	17.8384
13.0	11.5033	19.4209
13.5	12.4449	21.0666
14.0	13.4204	22.7755
14.5	14.4297	24.5476

Reaction

Sheet pile reaction “R” is at bottom of abutment cap.





Curve indicates Maximum “L” to “H” ratio
for each type of sheet pile.

Chapter 5
Special Provisions

Note: There are two different numbering formats used in Chapter 5.

1. 5.B-XX This format indicates Bridge Special Provisions not on file with PS&E. The “B” represents the Bridge Division; “XX” is the assigned number. These Special Provisions may at some time in the future be submitted as a Standard Special Provision.
2. 5.SYY-XX This format indicates a Standard Special Provision, which is on file with PS&E. S for English units; “YY” represents the Division of the ’97 Standard Specifications *(i.e. 1-10);* “XX” is the assigned number. These provisions are used repeatedly in the projects without making changes. If changes are required, they should be submitted to PS&E as redline changes to a copy of the provision. This will clearly indicate what changes are to be made without comparing the documents word for word.

   All Special Provisions shall include English units.

5.B-1 – Expansion Device Installation Special Provision

Any expansion device installation that fails to meet manufacturer's installation specifications will be removed and replaced with a properly installed joint at the expense of the contractor. No payment will be made unless the manufacturer's representative certifies the installation.

5.B-2 - Direct Tension Indicators

Paragraph 10.h. of Subsection 708.03 in the Nebraska Standard Specifications is void and superseded by the following:

h. Direct Tension Indicators (DTIs):

1. High strength fasteners shall be installed using Direct Tension Indicators (DTIs).
2. Self-indicating *(Squirter)* type DTIs that meet the requirements of ASTM F959/F959M shall be used.
3. DTIs shall be installed in accordance with Division II, Article 11.5.6.4.7 of the AASHTO Standard Specifications, 17th edition.
4. The contractor shall provide to the Engineer a detailed inspection instructions prepared by the manufacturer for approval.
5. At the start of work, representative samples shall be submitted to the NDOR Materials and Research Division for testing in the tension calibration device to demonstrate that the DTIs supplied are within the compression load ranges in Table 3 of ASTM F959/F959M.
6. Installation and tightening of individual bolts with Squirter DTIs shall be in accordance with manufacturer instructions.
7. The Direct Tension Indicators shall be stored in an environment that preserves the surface condition supplied by the manufacturer.
8. Reuse of Direct Tension Indicators is not allowed.

5.B-3 – Plans and Working Drawings

Paragraph 6.c. of Subsection 105.02 in the 1997 English Edition of the Standard Specifications is void and superseded by the following:

C. 1. The project number, structure number, control number and project location as it appears on the plans, shall be shown on each sheet of all shop drawings.

2. For steel girder bridges, all shop details shall follow girders numbering system as it appears on the plans.

5.B-4 – Bearing Shop Plan Special Provisions

The contractor must show the following applicable notes on the bearing Shop Plans.

1. All manufacturing, testing and certification of these materials shall be in accordance with the NDOR Standard Specifications, Section 712-“Fixed Bearings and Expansion Bearings, TFE Type”.

2. Certification shall include all required test reports indicating that the static and kinetic coefficient of friction between the sliding surfaces does not exceed 0.08 at the pressure of 500 psi and shall state that all materials used in the fabrication of the bearing assemblies comply with requirements of the NDOR Specifications.

3. Testing shall be in accordance with the AASHTO Standard Specifications for Highway Bridges.

4. The assemblies shall be suitably packaged to prevent damage during shipment and storage.

5. Flame cut edges of sole plates shall be ground to reduce hardness and facilitate blast cleaning.

6. All corners of sole plates shall be rounded to a 1/16-inch radius.

7. All exposed plain steel surfaces shall be blast cleaned to a near white finish and then zinc metallized with a minimum thickness of 8.0 mile. Zinc metallizing shall be according to AWS C2.2.

8. Stainless steel plate shall be attached by welding around its full perimeter. The weld shall not extend into the contact area between upper and lower assemblies.

9. Bonding must be complete without air gaps between the TFE sheet and Elastomeric bearing pad in order to seal out moisture and provide a smooth, flat slide surface.

10. The flatness tolerance for the TFE sheet and the stainless steel plate shall be 0.0005 x “Nominal Dimension”.

5.B-5 – Wet Joint Girder Splice

Description

This work shall consist of forming, pouring, and curing wet joint girder splice(s) over temporary support(s) as shown in the plans and in accordance with Section 705 of the Standard Specifications for Highway Construction and this special provision.

Material Requirements

a. The concrete mix for wet joint girder splices shall be in accordance with Section 705 of the 1997 Standard Specifications for Highway Construction.

b. The 28-day design strength of the concrete shall be as specified on the plans.

c. A three-cylinder sample shall be taken per day or per batch but not fewer than six cylinders for the entire bridge. The cylinders will be tested according to ASTM C31.

Construction Methods

a. The girder elevation at the temporary support(s) must be verified prior to pouring the wet joint girder splice(s).

b. Forms for the joint splice(s) will not be removed before the concrete has attained 75% of its 28-day design strength.

c. Temporary supports for the joint splice(s) shall not be removed before post-tensioning takes place.

Method of Measurement and Basis of Payment

The wet joint girder splice(s) will not be measured and paid for directly but will be considered subsidiary to the pay item “Precast-Prestressed/Post-tensioned Concrete Superstructure at Sta. _____”.

5.B-6 – Temporary Support

Description

This work shall consist of furnishing and erecting temporary supports for prestressed girders to the elevation shown in the plans until the wet joint splice(s) are poured and after the post-tensioning opration had taken place.

Material Requirements

a. Temporary supports shall have adequate bracing and stiffeners to withstand the forces due to girder weight, placement and vibration of concrete.

b. The Temporary Support shall be designed by a licensed professional engineer registered in the State of Nebraska.

c. The contractor shall submit a copy of the temporary support plans and design computations to the engineer for information only.

Construction Methods

a. The temporary support(s) shall be equipped so that it will allow slow and gradual lowering in case the upward deflection due to post tensioning does not cause the girders to raise off the temporary support(s) completely. Screw jacks may be used.

b. The temporary support shall be designed so that it will not settle.

Method of Measurement and Basis of Payment

a. This item shall be paid for at the contract unit price per each for the item, “Temporary Supports”.

b. This price shall be full compensation for designing, furnishing, erection, and removal of the temporary supports.

c. This item shall also include all labor, tools, equipment, and other incidentals necessary to complete the work.

5.B-7 – Bridge Shoring

Paragraph 1 of Subsection 701.02 in the 1997 Standard Specifications is void and superseded by the following:

1. a. The Contractor shall excavate and place shoring, as necessary, to insure safe access to work areas.

   b. (1) Adequate shoring must be installed by the contractor during phased construction to retain the existing and proposed roadway fill.

   (2) The shoring shall be in place before starting the grading work for the first phase of construction.

   (3) The shoring shall not be exposed to traffic at any time.

   (4) Shoring shall be designed by a Professional Engineer registered in the State of Nebraska.

   (5) The calculations and shoring plans shall bear the seal of the designer and four copies of each shall be submitted to the Engineer before construction. These calculations and plans will be for informational purposes only. The contractor is solely responsible for the satisfactory construction and performance of the shoring.

   (6) Shoring indicated in the plans as bridge shoring will not be pulled. Any removal required shall be made by flame cutting unless approved otherwise by the Engineer. Flame cutting will be to a minimum of 4” below the bottom of the roadway paving or approach slabs and as required to allow construction of the abutments or grade beams.

   (7) Shoring indicated in the plans as temporary bridge shoring shall be removed by the contractor.

   (8) Bridge shoring and temporary shoring shall be measured for payment by the lump sum and paid for as Bridge Shoring and Temporary Bridge Shoring. This price shall be full compensation for designing, furnishing, installing, maintaining and removing the temporary shoring and for all labor, materials, equipment, tools and incidentals necessary to complete the work.

5.B-8 – Concrete Construction

Paragaph 3 of Section 704.04 of the Standard Specifications for Highway Construction is void and superceded by the following:

3. The volume of concrete piles, cast-in-place concrete piles or steel pipe piles encased in the concrete shall be excluded from the concrete plan quantity.

5.S7-1 – 1 ½-Inch Electrical Conduit (S7-1-0801)

Description

This work will consist of furnishing and installing a complete electrical conduit system and anchor bolt assembly as shown in the plans. The anchor bolt assembly will include nuts, washers, anchor bolts, and miscellaneous hardware. The electrical conduit system will include all conduit, couplings, and all other miscellaneous conduit hardware. This work will also include all equipment, tools, labor, excavation, backfill, materials, and incidentals necessary to complete the work.

Material Requirements

Junction boxes for use in bridge conduit systems shall be 10” x 6” x 6” in dimension and of NEMA Type 4 watertight and dust-tight construction. Boxes shall be of machineable quality gray iron castings, outside flanged with recessed cover and designed especially for flush mounting in masonry. Cover and box shall have a hot-dip galvanized finish. Cover shall be gasketed and secured to the box with hex head stainless steel screws. Conduit entrance into the box shall be through slip holes. Fasten conduit to box using sealing type locknuts. Provide O-Z Gedney Box YR 100606, Spring City box ER 100606, Crouse Hinds box WGB 100606 or approved equal.

All electrical conduit and fittings shall be PVC and bear the U.L. Label. Fittings used with liquid-tight flexible conduit must be approved for the application.

The complete anchor bolt assembly, as shown in the plans, will be galvanized in accordance with ASTM A153. Anchor bolts must be threaded 4 inches on both ends and conform to the requirements of AASHTO M3124, Grade 55. Each anchor bolt shall be furnished complete with four heavy hex nuts meeting the requirements of AASHTO M291, Grade A; and two hardened steel flat washers conforming to AASHTO M293. The contractor shall furnish a certirfication stating that the anchor bolt material was manufactured and tested in accordance with the applicable specification. The certification shall include a report of the tensile test results and chemical analysis. The report shall also include the name of the steel producer, AASHTO or ASTM designation number, grade, heat number, size and authorized signature.

Construction Methods

The conduit installation must be performed by or under the direct supervision of a competent Journeyman Electrician or Lineman and conform to the requirements of the National Electric Code and the NDR Standard Specifications. Electrical conduit bends, elbows, and offsets must be accurately formed.

Conduit drains with a 1-inch projection from the concrete face, must be provided at each junction box and at low spots in the electrical conduit.

Expansion fittings shall be installed with conduit positioned with respect to ambient temperature and shall bear the U.L. label.

Method of Measurement

The electrical conduit system will be measured for payment by the number of feet shown in the plans within the limits defined for the system.

Basis of Payment

The electrical conduit system, in place and accepted by the engineer, will be paid for at the contract unit price per foot for the item, "1½-inch Conduit in Bridge".

Payment is full compensation for all work prescribed in this provision.

5.S7-4 – Stay in Place Bridge Forms *(S7-4-1201)*

Steel stay-in-place forms will be allowed for concrete floor slabs on steel or precast concrete "I" girders. Stay-in-place forms shall be used for interior areas only, where the forms are supported on both sides by girders. Stay-in-place forms must be adjustable to maintain proper slab thickness and shall be designed so no measurable settlement of forms occurs when the concrete deck is poured. Removable forms must be used outside of the exterior girders.

The Contractor must submit four copies of the stay-in-place form design plans and computations to the Engineer prior to construction. These plans and computations are for information only. The Contranctor is responsible for the performance of the stay-in-place forms.

Steel stay-in-place form material shall conform to the requirements of ASTM A 653/A 653M Coating Designation G615/Z500.

The form corrugations shall be filled with polystyrene strips to prevent excess slab dead load.

Th stay-in-place forms will not be measured and paid for directly but shall be considered subsidiary to the item Class 47BD-____ Concrete for Bridges.

Chapter 6
Bridge Base Sheets

Note: Designers shall refer to Standard Plans No. 617-R3

TITLECTE2.DGN

PROJECT NUMBER	SHEET NO.

C.N.

STRUCTURE NUMBER

BRIDGE ENGINEER

- PRESTRESSED CONCRETE "I" GIRDER -

- NOTES -

This structure is designed in accordance with the AASHTO "Standard Specifications for Highway Bridges", 16th edition.

The contractor may substitute any one of the alternate designs shown on the plans for the original design. All quantities are based on the original design and no additions or deductions will be allowed for the use of an alternate design.

The prestressed girders have been designed assuming 100% continuity at the interior supports for live load.

The concrete bridge deck is designed by the empirical design method in accordance with AASHTO LRFD second edition. The girders are designed by Load Factor Design method and for a future wearing surface of 20 Psf.

Prestressed concrete girders must be at least 9 days old before they can be set on the bridge substructure. Surveying for shim shots, forming bridge deck or diaphragms and placing construction material on the girders is not allowed until the girders are at least 30 days old.

The contractor must provide any temporary intermediate diaphragms and/or bracing necessary to provide lateral and torsional stability for the girders during construction of concrete slab. The temporary intermediate diaphragms/bracing shall be removed after the concrete slab has attained 75% of its design strength. The cost of furnishing, installing and removing the temporary intermediate diaphragms and/or bracing shall be subsidiary to the item "CLASS 47BD-4000 CONCRETE FOR BRIDGES".

Concrete for slab, approach slabs, diaphragms and rails shall be Class "47BD" with a 28-day strength of 4000 Psi.

All other cast-in-place concrete shall be Class "47B" concrete with a 28-day strength of 3000 Psi.

All reinforcing steel shall be epoxy coated and conform to the requirements of ASTM A615/A615M, Grade 60 steel.

The minimum clearance, measured from the face of the concrete to the surface of any reinforcing bar, shall be 3", except where otherwise noted.

All other structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

The item "STRUCTURAL STEEL FOR SUBSTRUCTURE", shall include nose angles at the bents.

All dimensions shown are in horizontal plane only. No allowance have been made for vertical curve or roadway cross slope.

All plastic pipe, galvanized wire screen and miscellaneous drainage items at the abutments shall be considered subsidiary to the item "SUBSURFACE DRAINAGE MATTING".

Girder shims that will be provided to the contractor account for dead load deflection due to the weight of the slab and rail only. The contractor is responsible for making the necessary adjustments for the particular forming system used to achieve the slab grades and elevations shown on the plans.

- QUANTITIES -

ABUTMENT NO. 1 EXCAVATION		1 LUMP SUM
PIER NO. 1 EXCAVATION		1 LUMP SUM
ABUTMENT NO. 2 EXCAVATION		1 LUMP SUM
CLASS 47B-3000 CONCRETE FOR BRIDGES		CU. YD.
ABUTMENTS	CU. YD.	
PIERS	CU. YD.	
CLASS 47BD-4000 CONCRETE FOR BRIDGES		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
PRECAST/PRESTRESSED CONCRETE SUPERSTRUCTURE AT STATION +		1 LUMP SUM
GIRDERS	CU. YD.	
EPOXY COATED REINFORCING STEEL		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	
ABUTMENTS	LBS.	
PIERS	LBS.	
STEEL DIAPHRAGMS		EACH
STRUCTURAL STEEL FOR SUBSTRUCTURE		LBS.
STEEL SHEET PILING		SQ. FT.
HP 10 In. x 42 Lbs. STEEL PILING		LIN. FT.
EXPANSION BEARING, TFE TYPE		EACH
FIXED BEARING		EACH
GRANULAR BACKFILL		CU. YD.
SUBSURFACE DRAINAGE MATTING		SQ. YD.
BROKEN CONCRETE RIPRAP		TONS
RIPRAP FILTER FABRIC		SQ. YD.
CONCRETE FOR PAVEMENT APPROACHES CLASS 47BD-4000		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
EPOXY COATED REINFORCING STEEL FOR PAVEMENT APPROACHES		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	
STRIP SEAL		LIN. FT.

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GENERAL NOTES, QUANTITIES & INDEX

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

DESIGNED BY
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

SPECIAL PLAN NO.

Sheet A

6.1.1

TITLECTE2.DGN

PROJECT NUMBER	SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

- PRESTRESSED CONCRETE "IT" GIRDER -

- NOTES -

This structure is designed in accordance with the AASHTO "Standard Specifications for Highway Bridges" 16th edition.

The contractor may substitute any one of the alternate designs shown on the plans for the original design. All quantities are based on the original design and no additions or deductions will be allowed for the use of an alternate design.

The prestressed girders have been designed assuming 100% continuity at the interior supports for live load.

The superstructure of this bridge is designed by Load Factor Design method and for a future wearing surface of 20 Psf.

Prestressed concrete girders must be at least 9 days old before they can be set on the bridge substructure. Surveying for shim shots, forming bridge deck or diaphragms and placing construction material on the girders is not allowed until the girders are at least 30 days old.

Concrete for slab, approach slabs, diaphragms and rails shall be Class "47BD" with a 28-day strength of 4000 Psi.

All other cast-in-place concrete shall be Class "47B" concrete with a 28-day strength of 3000 Psi.

All reinforcing steel shall be epoxy coated and conform to the requirements of ASTM A615/A615M, Grade 60 steel.

The minimum clearance, measured from the face of the concrete to the surface of any reinforcing bar, shall be 3", except where otherwise noted.

All other structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

The item "STRUCTURAL STEEL FOR SUBSTRUCTURE", shall include nose angles at the bents.

All dimensions shown are in horizontal plane only. No allowance have been made for vertical curve or roadway cross slope.

All plastic pipe, galvanized wire screen and miscellaneous drainage items at the abutments shall be considered subsidiary to the item "SUBSURFACE DRAINAGE MATTING".

Girder shims that will be provided to the contractor account for dead load deflection due to the weight of the slab and rail only. The contractor is responsible for making the necessary adjustments for the particular forming system used to achieve the slab grades and elevations shown on the plans.

- QUANTITIES -

ABUTMENT NO. 1 EXCAVATION		1 LUMP SUM
PIER NO. 1 EXCAVATION		1 LUMP SUM
ABUTMENT NO. 2 EXCAVATION		1 LUMP SUM
CLASS 47B-3000 CONCRETE FOR BRIDGES		CU. YD.
ABUTMENTS	CU. YD.	
PIERS	CU. YD.	
CLASS 47BD-4000 CONCRETE FOR BRIDGES		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
PRECAST/PRESTRESSED CONCRETE SUPERSTRUCTURE AT STATION +		1 LUMP SUM
GIRDERS	CU. YD.	
EPOXY COATED REINFORCING STEEL		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	
ABUTMENTS	LBS.	
PIERS	LBS.	
STRUCTURAL STEEL FOR SUBSTRUCTURE		LBS.
STEEL SHEET PILING		SQ. FT.
HP 10 in. x 42 Lbs. STEEL PILING		LIN. FT.
GRANULAR BACKFILL		CU. YD.
SUBSURFACE DRAINAGE MATTING		SQ. YD.
BROKEN CONCRETE RIPRAP		TONS
RIPRAP FILTER FABRIC		SQ. YD.
CONCRETE FOR PAVEMENT APPROACHES CLASS 47BD-4000		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
EPOXY COATED REINFORCING STEEL FOR PAVEMENT APPROACHES		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	
STRIP SEAL		LIN. FT.

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GENERAL NOTES, QUANTITIES & INDEX

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

DESIGNED BY
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

9.1.2

Sheet B

TITLECTE2.DGN

Sheet C

- WELDED PLATE GIRDER -

- NOTES -

This structure is designed in accordance with the AASHTO "Standard Specifications for Highway Bridges", 16th edition.

The contractor may substitute any one of the alternate designs shown on the plans for the original design. All quantities are based on the original design and no additions or deductions will be allowed for the use of alternate design.

All structural steel for girder flanges, webs, stiffeners and separators and all splice material shall conform to the requirements of ASTM A709/A709M, Grade 50W weathering steel.

Nuts, bolts and washers used in the assembly of weathering steel shall be Type 3.

During girder fabrication, the final camber tolerance shall not exceed those in table 3.3 of A.W.S. "S" is the length of girder between field splices.

During girder fabrication, the flanges at the splice must line up within 1/8" of parallel to the adjacent flanges without applying external force, before the splice is drilled.

Field splices shall be cleaned before field assembly. The plates shall be in full contact when the bolts are tightened to a snug-tight connection.

When assembling the girders in the field, they shall be set according to the blocking diagram before any bolts are tightened to a snug-tight condition.

Field tack welding of form hangers or miscellaneous hardware to any part of the steel girder, except shear connectors, shall be prohibited.

All bearing stiffeners and girder ends, except at field splices, shall be vertical after final erection. All other stiffeners and all field splices shall be normal to the top flange.

The contractor may eliminate any butt welded flange splice by extending the heavier of the two plates so connected. The contractor shall make any necessary adjustments in bearings and bearing seat elevations caused by flange plate changes. This shall be shown on the shop plans and will be subject to approval by the Engineer. No change in the contract price or quantities will be made for this substitution.

All fasteners shall be 7/8" Φ high strength bolts, ASTM A325.

The girders for this bridge are not designed to resist any torsional or lateral forces due to temporary construction loads. The contractor must provide any temporary bracing necessary to support the girder web and flanges against all torsional forces resulting from construction loads.

The concrete bridge deck is designed by the empirical design method in accordance with AASHTO LRFD second edition. The girders are designed by Load Factor Design method and for a future wearing surface of 20 Psf.

Concrete for slab, approach slabs, diaphragms and rails shall be Class "47BD" with a 28-day strength of 4000 Psi.

All other cast-in-place concrete shall be Class "47B" with a 28-day strength of 3000 Psi.

The minimum clearance, measured from the face of the concrete to the surface of any reinforcing bar, shall be 3", except where otherwise noted.

All reinforcing steel shall be epoxy coated and conform to the requirements of ASTM A615/A615M, Grade 60 steel.

All other structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

All plastic pipe, galvanized wire screen and miscellaneous drainage items at the abutments shall be considered subsidiary to the item "SUBSURFACE DRAINAGE MATTING".

All dimensions shown are in horizontal plane only. No allowance have been made for vertical curve or roadway cross slope.

Girder shims that will be provided to the contractor account for dead load deflection due to the weight of the slab and rail only. The contractor is responsible for making the necessary adjustments for the particular forming system used to achieve the slab grades and elevations shown on the plans.

- QUANTITIES -

ABUTMENT NO. 1 EXCAVATION		1 LUMP SUM
PIER NO. 1 EXCAVATION		1 LUMP SUM
ABUTMENT NO. 2 EXCAVATION		1 LUMP SUM
CLASS 47B-3000 CONCRETE FOR BRIDGES		CU. YD.
ABUTMENTS	CU. YD.	
PIERS	CU. YD.	
CLASS 47BD-4000 CONCRETE FOR BRIDGES		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
STEEL SUPERSTRUCTURE AT STA. +		1 LUMP SUM
GIRDERS	LBS.	
SEPARATORS & MISC.	LBS.	
TOTAL	LBS.	
EPOXY COATED REINFORCING STEEL		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	
ABUTMENTS	LBS.	
PIERS	LBS.	
STRUCTURAL STEEL FOR SUBSTRUCTURE		LBS.
STEEL SHEET PILING		SQ. FT.
HP 12 in. x 53 Lbs. STEEL PILING		LIN. FT.
EXPANSION BEARING, TFE TYPE		EACH
FIXED BEARING		EACH
GRANULAR BACKFILL		CU. YD.
SUBSURFACE DRAINAGE MATTING		SQ. YD.
BROKEN CONCRETE RIPRAP		TONS
RIPRAP FILTER FABRIC		SQ. YD.
CONCRETE FOR PAVEMENT APPROACHES CLASS 47BD-4000		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
EPOXY COATED REINFORCING STEEL FOR PAVEMENT APPROACHES		LBS.
SLAB	LBS.	
CONCRETE RAIL	LBS.	
STRIP SEAL		LIN. FT.

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PROJECT NUMBER	SHEET NO.
C.N.	
STRUCTURE NUMBER	
BRIDGE ENGINEER	
LOCATION	
SKEW	
ROADWAY	
DESIGN LIVE LOAD	
COUNTY	
HWY. NO.	
REF. POST.	
STA.	
DESIGNED BY	
DETAILED BY	
CHECKED BY	
DATE	
SPECIAL PLAN NO.	

GENERAL NOTES, QUANTITIES & INDEX

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

6.1.3

TITLECTE2.DGN

PROJECT NUMBER	SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

- TWIN TEE BRIDGE -

- NOTES -

This Structure is designed in accordance with the AASHTO "Standard Specifications for Highway Bridges", 16th edition .

The superstructure of this bridge is designed by Load Factor Design method and for a future wearing surface of 20 Psf.

The contractor may substitute any of the alternate designs shown on the plans for the original design. All quantities are based on the original design and no additions or deductions will be allowed for the use of an alternate design.

The prestressed concrete girders must be at least 9 days old before they can be set on the bridge substructure. Surveying for shim shots, forming bridge deck or diaphragms and placing construction material on the girder is not allowed until the girders are at least 30 days old.

The prestressed girders have been designed assuming 100% continuity at the interior supports for live load.

Concrete for slab, approach slabs, diaphragms and rails shall be Class "47BD", with a 28-day strength of 4000 Psi.

All other cast-in-place concrete shall be Class "47B"concrete with a 28-day strength of 3000 Psi.

All reinforcing steel shall be epoxy coated and conform to the requirements of ASTM A615/A615M, Grade 60 steel.

The minimum clearance, measured from the face of the concrete to the surface of any reinforcing bar, shall be 3", except where otherwise noted.

All other structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

The item, "STRUCTURAL STEEL FOR SUBSTRUCTURE", shall include nose angles at the bents.

All plastic pipe, galvanized wire screen and miscellaneous drainage items at the abutments shall be considered subsidiary to the item SUBSURFACE DRAINAGE MATTING.

All dimensions shown are in horizontal plane only. No allowance have been made for vertical curve or roadway cross slope.

Girder shims that will be provided to the contractor account for dead load deflection due to the weight of the slab and rail only. The contractor is responsible for making the necessary adjustments for the particular forming system used to achieve the slab grades and elevations shown on the plans.

- QUANTITIES -

ABUTMENT NO. 1 EXCAVATION		1 LUMP SUM
BENT NO. 1 EXCAVATION		1 LUMP SUM
ABUTMENT NO. 2 EXCAVATION		1 LUMP SUM
CLASS 47B-3000 CONCRETE FOR BRIDGES		CU. YD.
ABUTMENTS	CU. YD.	
BENTS	CU. YD.	
CLASS 47BD-4000 CONCRETE FOR BRIDGES		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
PRECAST/PRESTRESSED CONCRETE SUPERSTRUCTURE AT STATION +		1 LUMP SUM
GIRDERS	CU. YD.	
EPOXY COATED REINFORCING STEEL		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	
ABUTMENTS	LBS.	
BENTS	LBS.	
STRUCTURAL STEEL FOR SUBSTRUCTURE		LBS.
STEEL SHEET PILING		SQ. FT.
HP 10 in. x 42 Lbs. STEEL PILING		LIN. FT.
GRANULAR BACKFILL		SQ. YD.
SUBSURFACE DRAINAGE MATTING		SQ. YD.
BROKEN CONCRETE RIPRAP		TONS
RIPRAP FILTER FABRIC		SQ. YD.
CONCRETE FOR PAVEMENT APPROACHES CLASS 47BD-4000		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
EPOXY COATED REINFORCING STEEL FOR PAVEMENT APPROACHES		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	
STRIP SEAL		LIN. FT.

- INDEX -

COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY

CHECKED BY
DATE

GENERAL NOTES, QUANTITIES & INDEX

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

9.1.4

Sheet D

TITLECTE2.DGN

Sheet E

PROJECT NUMBER	SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

- CONCRETE SLAB BRIDGE -

- NOTES -

This structure is designed in accordance with the AASHTO "Standard Specifications for Highway Bridges", 16th edition.

The superstructure of this bridge is designed by Load Factor Design method and for a future wearing surface of 20 Psf.

The contractor may substitute any one of the alternate designs shown on the plans for the original design. All quantities are based on the original design and no additions or deductions will be allowed for the use of an alternate design.

All plastic pipe, galvanized wire screen, and miscellaneous drainage items at the abutments shall be considered subsidiary to the item "SUBSURFACE DRAINAGE MATTING".

Concrete for slab, approach slabs and rails shall be Class "47BD", with a 28-day strength of 4000 Psi.

All other cast-in-place concrete shall be Class "47B" concrete, with a 28-day strength of 3000 Psi.

All reinforcing steel shall be epoxy coated and conform to the requirements of ASTM A615/A615M, Grade 60 steel.

The minimum clearance, measured from the face of the concrete of any reinforcing bar, shall be 3", except where otherwise noted.

All structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

The item, "STRUCTURAL STEEL FOR SUBSTRUCTURE", shall include nose angles at the bents.

All dimensions shown are in horizontal plane only. No allowance have been made for vertical curve or roadway cross slope.

After fabrication, nose angles at the Bents shall be galvanized according to ASTM123/ASTM 123M.

Drainage Matting shall wrap around the sloping drain pipe and extend 3 ft. along the wings.

- QUANTITIES -

ABUTMENT NO. 1 EXCAVATION		1 Lump Sum
BENT NO. 1 EXCAVATION		1 Lump Sum
ABUTMENT NO. 2 EXCAVATION		1 Lump Sum
CLASS 47B-3000 CONCRETE FOR BRIDGES		CU. YD.
ABUTMENTS	CU. YD.	
BENTS	CU. YD.	
CLASS 47BD-4000 CONCRETE FOR BRIDGES		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
EPOXY COATED REINFORCING STEEL		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	
ABUTMENTS	LBS.	
BENT	LBS.	
STRUCTURAL STEEL FOR SUBSTRUCTURE		LBS.
STEEL SHEET PILING		SQ. FT.
HP 10 In. x 42 Lbs. STEEL PILING		LIN. FT.
GRANULAR BACKFILL		CU. YD.
SUBSURFACE DRAINAGE MATTING		SQ. YD.
BROKEN CONCRETE RIPRAP		TONS
RIPRAP FILTER FABRIC		SQ. YD.
CONCRETE FOR PAVEMENT APPROACHES CLASS 47BD-4000		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
EPOXY COATED REINFORCING STEEL FOR PAVEMENT APPROACHES		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	

- INDEX -

COUNTY
HWY. NO.
REF. POST.
STA.

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

DESIGNED BY
DETAILED BY
CHECKED BY
DATE

GENERAL NOTES, QUANTITIES & INDEX

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.1.5

TITLECTE2.DGN

- ROLLED BEAM -

- NOTES -

This structure is designed in accordance with the AASHTO" Standard Specifications for Highway Bridges", 16th edition.

The concrete bridge deck is designed by the empirical design method in accordance with AASHTO LRFD second edition. The girders are designed by Load Factor Design method and for a future wearing surface of 20 Psf.

The contractor may substitute any one of the alternate designs shown on the plans for the original design. All quantities are based on the original design and no additions or deductions will be allowed for the use of an alternate design.

All structural steel for rolled beams, stiffeners, separators and all splice material shall conform to the requirements of ASTM A709/A709M, Grade 50W weathering steel.

Nuts, bolts and washers used in the assembly of weathering steel shall be Type 3.

During girder fabrication, the flanges at the splice must line up within 1/8" of parallel to the adjacent flanges without applying external force, before the splice is drilled.

All rolled beams and splice plates shall be considered main tension members for the purpose of Charpy-V-Notch tests.

All fasteners shall be 7/8"Φ high strength bolts, ASTM A325.

Field tack welding of form hangers or miscellaneous hardware to any part of the steel girder, except shear connectors, shall be prohibited.

When assembling the girders in the field, they shall be set according to the blocking diagram before any bolts are tightened to a snug-tight condition.

Field splices shall be clean and free of all foreign matter before field assembly. The plates shall be in full contact when the bolts are tightened to a snug-tight condition.

The girders for this bridge are not designed to resist any torsional or lateral forces due to temporary construction loads. The contractor must provide any temporary bracing necessary to support the girder web and flanges against all torsional forces resulting from construction loads.

Concrete for slab, approach slabs and rails shall be class "47BD", with a minimum 28-day strength of 4000 Psi.

All other cast-in-place concrete shall be Class "47B" concrete, with a minimum 28-day strength of 3000 Psi.

All reinforcing steel shall be epoxy coated and conform to the requirements of ASTM A615/A615M, Grade 60 steel.

The minimum clearance, measured from the face of the concrete to the surface of any reinforcing bar, shall be 3", except where otherwise noted.

All other structural steel shall conform to the requirements of ASTM A709/A709M, Grade 36.

All plastic pipe, galvanized wire screen, and miscellaneous drainage items at the abutments shall be considered subsidiary to the item "SUBSURFACE DRAINAGE MATTING".

All dimensions shown are in horizontal plane only. No allowance have been made for vertical curve or roadway cross slope.

Girder shims that will be provided to the contractor account for dead load deflection due to the weight of the slab and rail only. The contractor is responsible for making the necessary adjustments for the particular forming system used to achieve the slab grades and elevations shown on the plans.

- QUANTITIES -

ABUTMENT NO. 1 EXCAVATION		1 LUMP SUM
PIER NO. 1 EXCAVATION		1 LUMP SUM
PIER NO. 2 EXCAVATION		1 LUMP SUM
ABUTMENT NO. 2 EXCAVATION		1 LUMP SUM
CLASS 47B-3000 CONCRETE FOR BRIDGES		CU. YD.
ABUTMENTS	CU. YD.	
PIERS	CU. YD.	
CLASS 47BD-4000 CONCRETE FOR BRIDGES		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
STEEL SUPERSTRUCTURE AT STA. +		1 LUMP SUM
GIRDERS	LBS.	
SEPARATORS & MISC.	LBS.	
TOTAL	LBS.	
EPOXY COATED REINFORCING STEEL		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	
ABUTMENTS	LBS.	
PIERS	LBS.	
STRUCTURAL STEEL FOR SUBSTRUCTURE		LBS.
STEEL SHEET PILING		SQ. FT.
HP 12 in. x 53 Lbs. STEEL PILING		LIN. FT.
EXPANSION BEARING, TFE TYPE		EACH
FIXED BEARING		EACH
GRANULAR BACKFILL		CU. YD.
SUBSURFACE DRAINAGE MATTING		SQ. YD.
BROKEN CONCRETE RIPRAP		TONS
RIPRAP FILTER FABRIC		SQ. YD.
CONCRETE FOR PAVEMENT APPROACHES CLASS 47BD-4000		CU. YD.
SLAB	CU. YD.	
CONCRETE RAILS	CU. YD.	
EPOXY COATED REINFORCING STEEL FOR PAVEMENT APPROACHES		LBS.
SLAB	LBS.	
CONCRETE RAILS	LBS.	
STRIP SEAL		LIN. FT.

- INDEX -

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

BRIDGE ENGINEER

GENERAL NOTES, QUANTITIES & INDEX

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

DESIGNED BY | DETAILED BY | CHECKED BY | DATE

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

SPECIAL PLAN NO.

Sheet F

6.1.6

BILBARCTE.DGN

BILL OF BARS

MARK	NUMBER OF BARS PHASE 1	NUMBER OF BARS PHASE 2	LENGTH	TYPE	"A"	"B"	"C"	"D"	"E"	"F"		PIN	HOOK	WEIGHT LBS

SUBTOTAL = LBS.

TOTAL = LBS.

BAR MARK

A413 A 4 13

- bar number:
  - 01 thru 49, general reinforcing
  - 70 thru 79, light pole reinforcing
  - 90 thru 99, curb or rail reinforcing
- bar size
- type of bridge element - A=Abutment (P=Pier, B=Bent, S=Slab, N=Approach Slab)

BAR SETS

MARK	MAX. LENGTH	MIN. LENGTH	NO. OF SETS	BARS PER SET

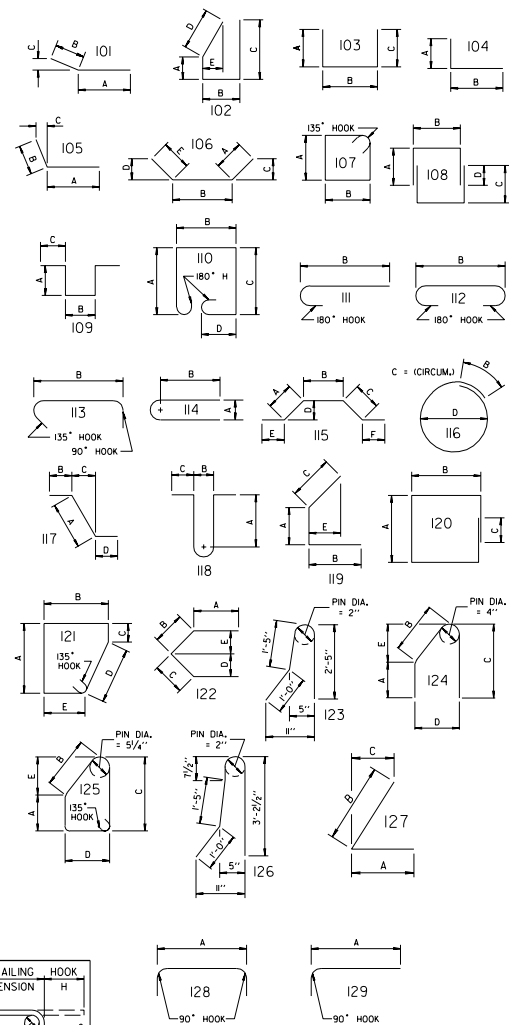
BAR SETS

MARK	MAX. LENGTH	MIN. LENGTH	NO. OF SETS	BARS PER SET

BENDING DIAGRAMS

ALL DIMENSIONS ARE OUT TO OUT & NOT TO SCALE

ALL REINFORCING STEEL SHALL BE EPOXY COATED



STANDARD HOOK LENGTH

PRIMARY STRESS BARS

BAR SIZE	HOOK H 90°	HOOK H 180°
4	8"	6"
5	10"	7"
6	12"	8"
7	15"	10"
8	17"	11"
9	19"	15"
10	23"	17"
11	24"	19"

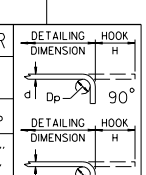
STIRRUPS AND TIES

BAR SIZE	HOOK H 90°	HOOK H 135°
3	4"	4"
4	4 ½"	4 ½"
5	6"	5 ½"
6	12"	8"
7	14"	9"
8	16"	10 ½"

d = BAR SIZE
Dp = PIN DIAMETER

PIN DIAMETER

PRIMARY STRESS BAR SIZE	PRIMARY STRESS Dp	STIRRUP & TIES BAR SIZE	STIRRUP & TIES Dp
4	3"	3	1 ½"
5	3 ¾"	4	2"
6	4 ½"	5	2 ½"
7	5 ¼"	6	4 ½"
8	6"	7	5 ¼"
9	9½"	8	6"
10	11"		
11	12"		



PROJECT NUMBER

SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

DATE

CHECKED BY

DESIGNED BY DETAILED BY

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.1.7

Sheet C

BILL OF BARS W/BENDING DIAGRAMS JULY 1993

BILBARCTE.DGN

BILL OF BARS

MARK	NO.	LENGTH	TYPE	"A"	"B"	"C"	"D"	"E"	"F"		PIN	HOOK	WEIGHT LBS

SUBTOTAL = LBS

TOTAL = LBS

BAR MARK

A413

- A = type of bridge element - A=Abutment (P=Pier, B=Bent, S=Slab,N=Approach Slab)
- 4 = bar size
- 13 = bar number
  - 01 thru 49, general reinforcing
  - 70 thru 79, light pole reinforcing
  - 90 thru 99, curb or rail reinforcing

BAR SETS					BAR SETS				
MARK	MAX. LENGTH	MIN. LENGTH	NO. OF SETS	BARS PER SET	MARK	MAX. LENGTH	MIN. LENGTH	NO. OF SETS	BARS PER SET

STANDARD HOOK LENGTH

PRIMARY STRESS BARS			STIRRUPS AND TIES		
BAR SIZE	HOOK H 90°	HOOK H 180°	BAR SIZE	HOOK H 90°	HOOK H 135°
4	8"	6"	3	4"	4"
5	10"	7"	4	4 1/2"	4 1/2"
6	12"	8"	5	6"	5 1/2"
7	15"	10"	6	12"	8"
8	17"	11"	7	14"	9"
9	19"	15"	8	16"	10 1/2"
10	23"	17"			
11	24"	19"			

d = BAR SIZE
Dp = PIN DIAMETER

PIN DIAMETER

PRIMARY STRESS		STIRRUP & TIES	
BAR SIZE	Dp	BAR SIZE	Dp
4	3"	3	1 1/2"
5	3 3/4"	4	2"
6	4 1/2"	5	2 1/2"
7	5 1/4"	6	4 1/2"
8	6"	7	5 1/4"
9	9 1/2"	8	6"
10	11"		
11	12"		

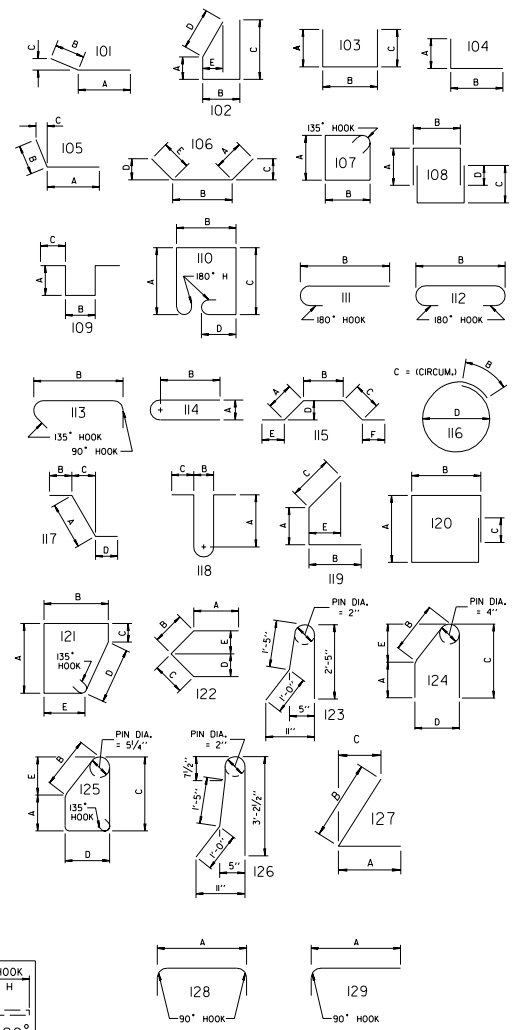
DETAILING DIMENSION — HOOK H — d — Dp — 90°

DETAILING DIMENSION — HOOK H — d — Dp — 135°

DETAILING DIMENSION — HOOK H — d — Dp — 180°

BENDING DIAGRAMS

ALL DIMENSIONS ARE OUT TO OUT & NOT TO SCALE
ALL REINFORCING STEEL SHALL BE EPOXY COATED



PROJECT NUMBER

SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

DATE

CHECKED BY

DESIGNED BY — DETAILED BY

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

Sheet D

6.1.8

* Shown on this page

*LEVEL 50 = Concrete Rail
LEVEL 51 = Concrete Barrier
LEVEL 52 = Asphalt Pavement
*LEVEL 53 = Concrete Pavement
LEVEL 54 = Strip Seal Joint
LEVEL 55 = 1" Preformed Joint
*LEVEL 56 = PPF Joint

APPCTE2.DGN

March 17, 2003

Sheet A

PROJECT NUMBER	SHEET NO.

C.N.

STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 — PROFESSIONAL STRUCTURAL ENGINEER — STATE OF NEBRASKA

BRIDGE ENGINEER

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
DESIGNED BY
CHECKED BY
DATE

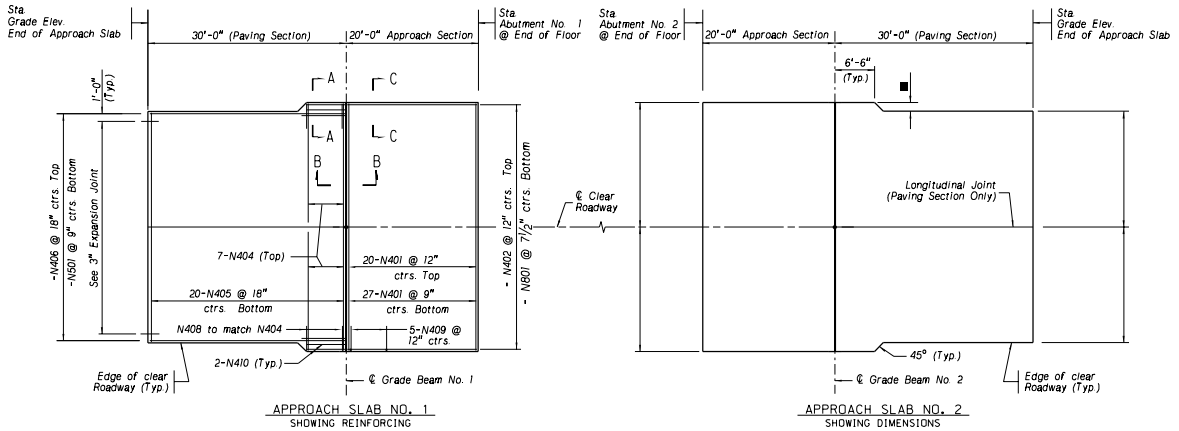
COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

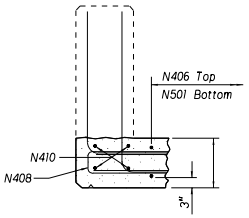
6.1.6



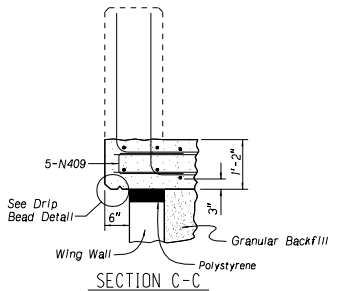
APPROACH SLAB NO. 1
SHOWING REINFORCING

APPROACH SLAB NO. 2
SHOWING DIMENSIONS

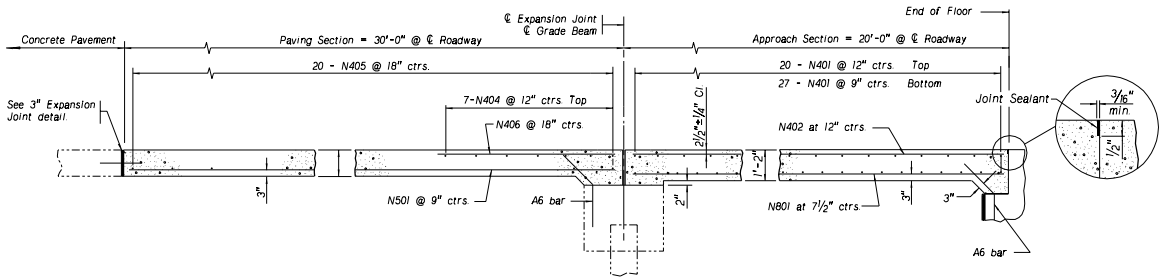
GENERAL PLAN OF APPROACH SLABS



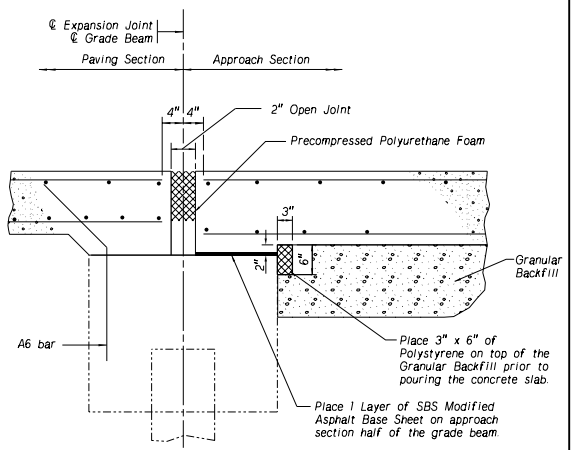
SECTION A-A
Typical



SECTION C-C

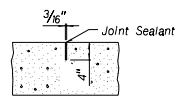


LONGITUDINAL SECTION

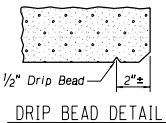


SECTION B-B

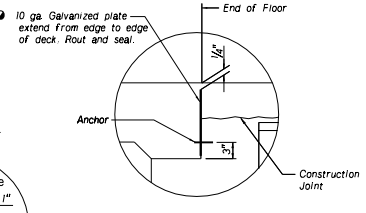
Note: DO NOT SAW CUT



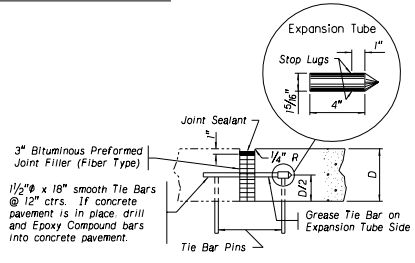
LONGITUDINAL JOINT



DRIP BEAD DETAIL



ALTERNATE JOINT DETAIL AT END OF FLOOR



3" EXPANSION JOINT

APPROACH SLAB NOTES:

- Concrete Rail Width = 1'-2". See sheet of for placement of rail reinforcement.

See Standard Specifications for tining and finishing of approach slabs.

SBS MODIFIED ASPHALT base sheets and all other miscellaneous items shall be considered subsidiary to the pay item. CONCRETE FOR PAVEMENT APPROACHES CLASS 47BD-4000.

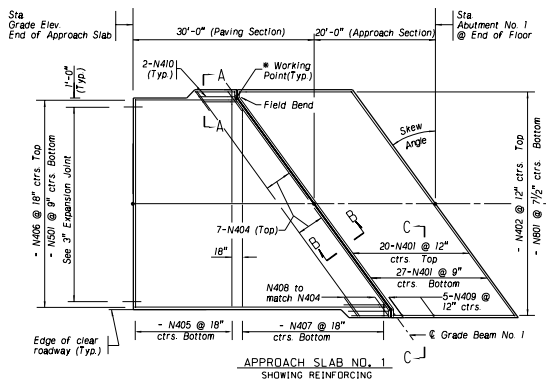
LONGITUDINAL JOINTS shall be 4" deep and placed in the paving slab in accordance with section 603.03 paragraph 7 of the Standard Specifications. Contractor shall exercise care not to damage reinforcing steel placed in the top layer of the paving slab.

The expansion gap between approach section and paving section shall be cleaned of all foreign matter before the installation of the expansion device or the filler material.

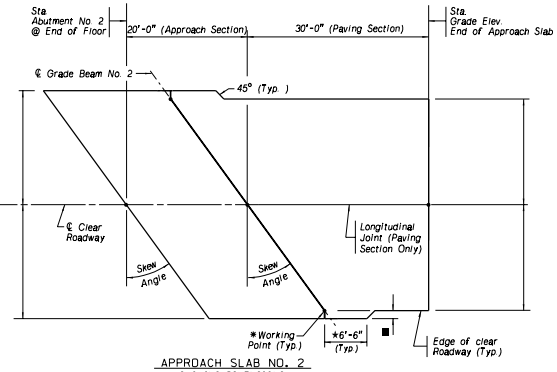
* Shown on this page

*LEVEL 50 = Concrete Rail
LEVEL 51 = Concrete Barrier
LEVEL 52 = Asphalt Pavement
*LEVEL 53 = Concrete Pavement
LEVEL 54 = Strip Seal Joint
*LEVEL 55 = 1" Preformed Joint
LEVEL 56 = PPF Joint

APPLTE2.DGN

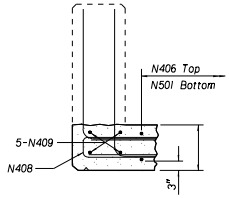


APPROACH SLAB NO. 1
SHOWING REINFORCING

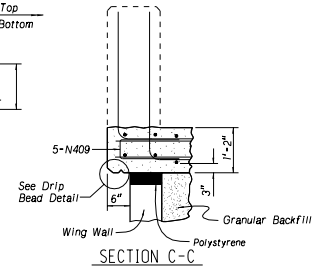


APPROACH SLAB NO. 2
SHOWING DIMENSIONS

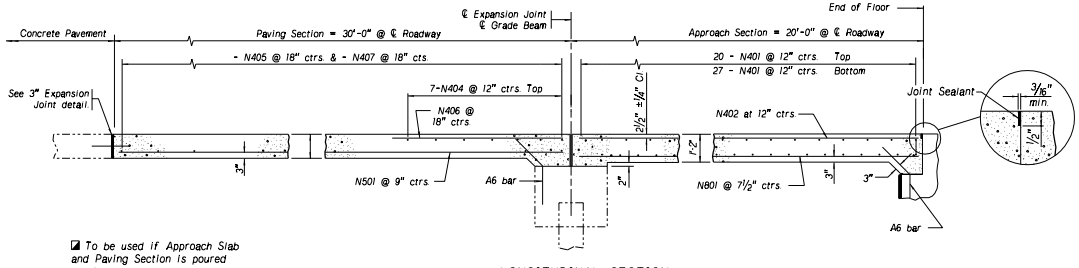
GENERAL PLAN OF APPROACH SLABS



SECTION A-A
Typical

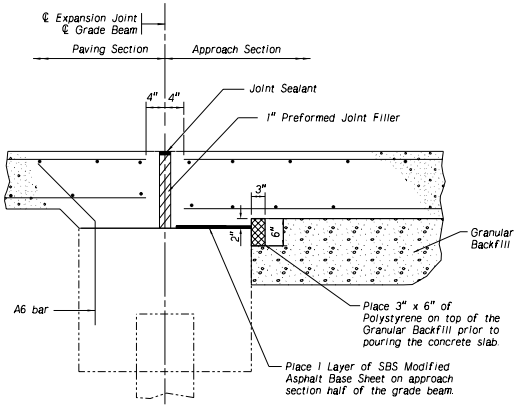


SECTION C-C

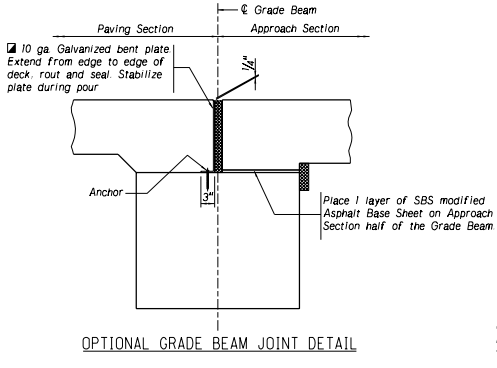


LONGITUDINAL SECTION

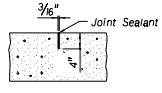
◪ To be used if Approach Slab and Paving Section is poured continuous.



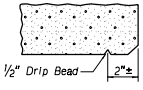
SECTION B-B
Note DO NOT SAW CUT



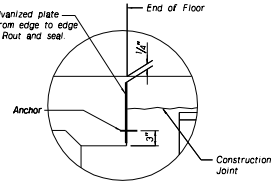
OPTIONAL GRADE BEAM JOINT DETAIL



LONGITUDINAL JOINT

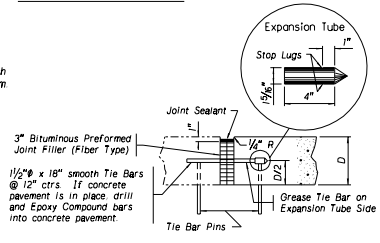


DRIP BEAD DETAIL



To be used if approach slab is poured continuous with bridge deck.
* Stabilize Plate during pour

ALTERNATE JOINT DETAIL AT END OF FLOOR



3" EXPANSION JOINT

APPROACH SLAB NOTES:

■ Concrete Rail Width = 1'-2". See sheet of for placement of rail reinforcement.

See Standard Specifications for fining and finishing of approach slabs.

SBS MODIFIED ASPHALT base sheets and all other miscellaneous items shall be considered subsidiary to the pay item. CONCRETE FOR PAVEMENT APPROACHES CLASS 47BD-30.

Longitudinal joints shall be 4" deep and placed in the paving slab in accordance with section 603.03 paragraph 7 of the Standard Specifications. Contractor shall exercise care not to damage reinforcing steel placed in the top layer of the paving slab.

* Working points are located at the intersection of the edge of clear roadway and ℄ Grade Beam.

★ Dimensions measured at edge of clear roadway.

The expansion gap between approach section and paving section will be cleaned of all foreign matter before the installation of the expansion device or the filler material.

PROJECT NUMBER	SHEET NO.

C.N.
STRUCTURE NUMBER

L. IVAN D. FRIEMOY E-2005 PROFESSIONAL STRUCTURAL ENGINEER STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

DESIGNED BY
DETAILED BY
CHECKED BY
DATE

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

COUNTY
HWY. NO.
REF. POST.
STA.

Nebraska

SPECIAL PLAN NO.

6.1.10

January 21, 2003

Sheet 8

* Shown on this page

*LEVEL 50 = Concrete Rail
LEVEL 51 = Concrete Barrier
LEVEL 52 = Asphalt Pavement
*LEVEL 53 = Concrete Pavement

*LEVEL 54 = Strip Seal Joint
LEVEL 55 = 1" Preformed Joint
LEVEL 56 = PPF Joint

APPCTE2.DGN

March 17, 2003

Sheet C

PROJECT NUMBER	SHEET NO.

C.N.

STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 — PROFESSIONAL STRUCTURAL ENGINEER — STATE OF NEBRASKA

BRIDGE ENGINEER

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

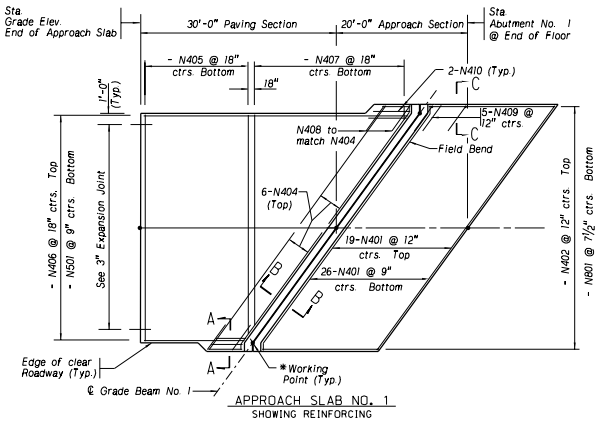
COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

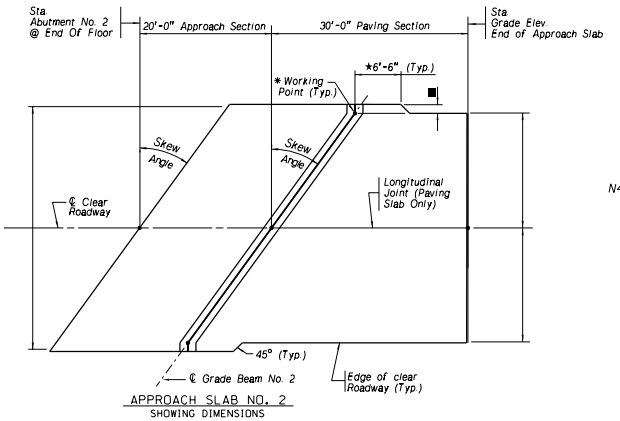
Nebraska

SPECIAL PLAN NO.

6.1.11

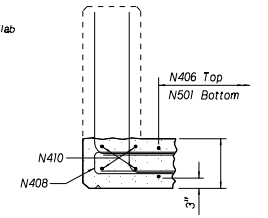


APPROACH SLAB NO. 1
SHOWING REINFORCING

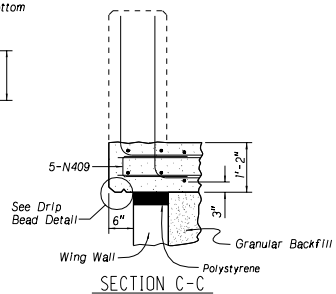


APPROACH SLAB NO. 2
SHOWING DIMENSIONS

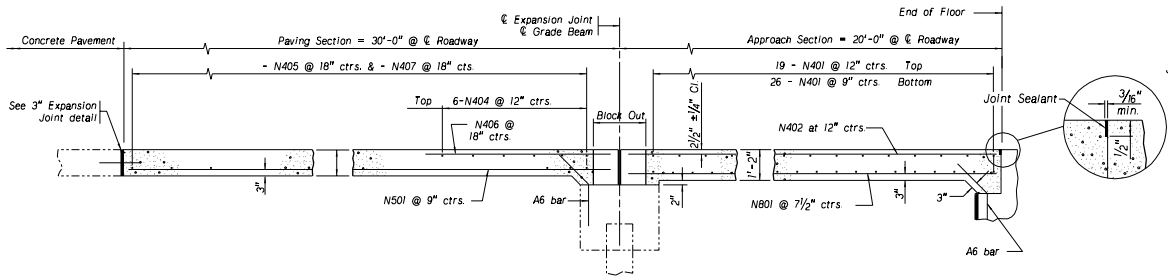
GENERAL PLAN OF APPROACH SLABS



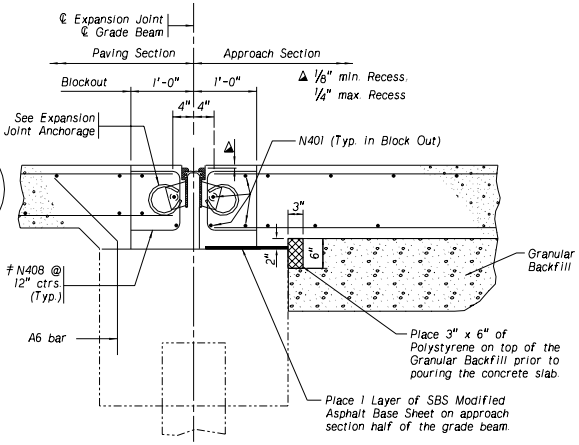
SECTION A-A
Typical



SECTION C-C

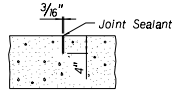


LONGITUDINAL SECTION

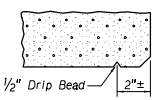


SECTION B-B

4" STRIP SEALS		
MANUFACTURER	EXTRUSION	SEAL
D. S. Brown Co.	SSPA	L2
Watson Bowman	P	SE-400

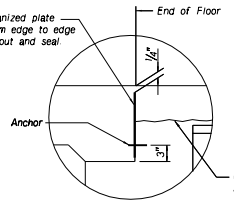


LONGITUDINAL JOINT



DRIP BEAD DETAIL

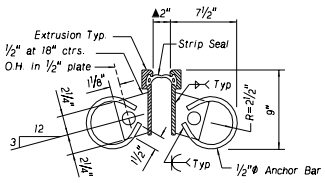
◕ 10 ga. Galvanized plate extend from edge to edge of deck. Rout and seal



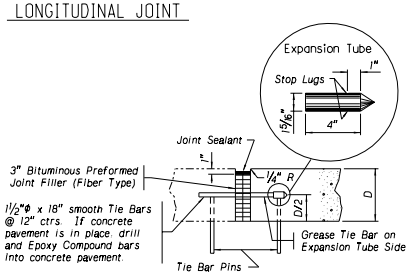
To be used if approach slab is poured continuous with bridge deck.
◕ Stabilize Plate during pour

ALTERNATE JOINT DETAIL AT END OF FLOOR

▲ Extrusions shall be set to grade and crown. Gap width at time of installation shall be based on ambient air temperature (±10°F). Dimensions marked thus (▲) are measured at 50°F. Gap width shall be decreased ⅛" for every °F increase in temperature above 50°F. Gap width shall be increased ⅛" for every °F decrease in temperature below 50°F. The seal shall be installed within the gap limits recommended by the manufacturer.



EXPANSION JOINT ANCHORAGE



3" EXPANSION JOINT

APPROACH SLAB NOTES:

■ Concrete Rail Width = 1'-2". See sheet of for placement of rail reinforcement.

See Standard Specifications for tining and finishing of approach slabs.

SBS MODIFIED ASPHALT base sheets and all other miscellaneous items shall be considered subsidiary to the pay item, CONCRETE FOR PAVEMENT APPROACHES CLASS 47BD-4000.

Longitudinal joints shall be 4" deep and placed in the paving slab in accordance with section 603.03 paragraph 7 of the Standard Specifications. Contractor shall exercise care not to damage reinforcing steel placed in the top layer of the paving slab.

* Working points are located at the intersection of the edge of clear roadway and ℄ Grade Beam.

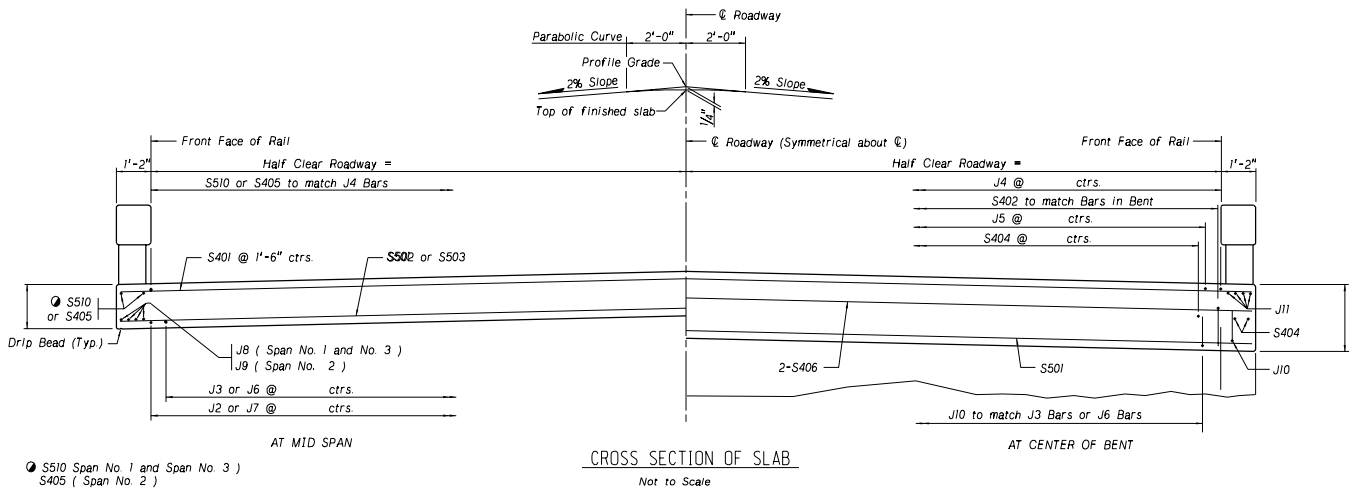
★ Dimensions measured at edge of clear roadway.

The expansion gap between approach section and paving section will be cleaned of all foreign matter before the installation of the expansion device or the filler material.

≠ Measured along ℄ Grade Beam.

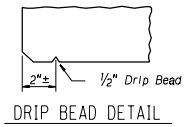
* Shown on this page

LEVEL 41 = 0 Skew or Less than 30°
*LEVEL 42 = Skew Greater than 30°

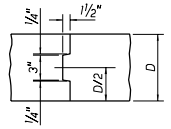


CROSS SECTION OF SLAB

Not to Scale



DRIP BEAD DETAIL



CONSTRUCTION JOINT

BILL OF BARS

MARK	NO.	LENGTH	TYPE	"A"	"B"	"C"	"D"	"E"	"F"		PIN	HOOK	WEIGHT LBS

SUBTOTAL = LBS

NOTE: FOR PIN DIAMETERS, HOOK LENGTHS & BENDING DIAGRAMS SEE SHEET OF .

TOTAL = LBS

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

DESIGNED BY
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

Nebraska

SPECIAL PLAN NO.

6.2.1

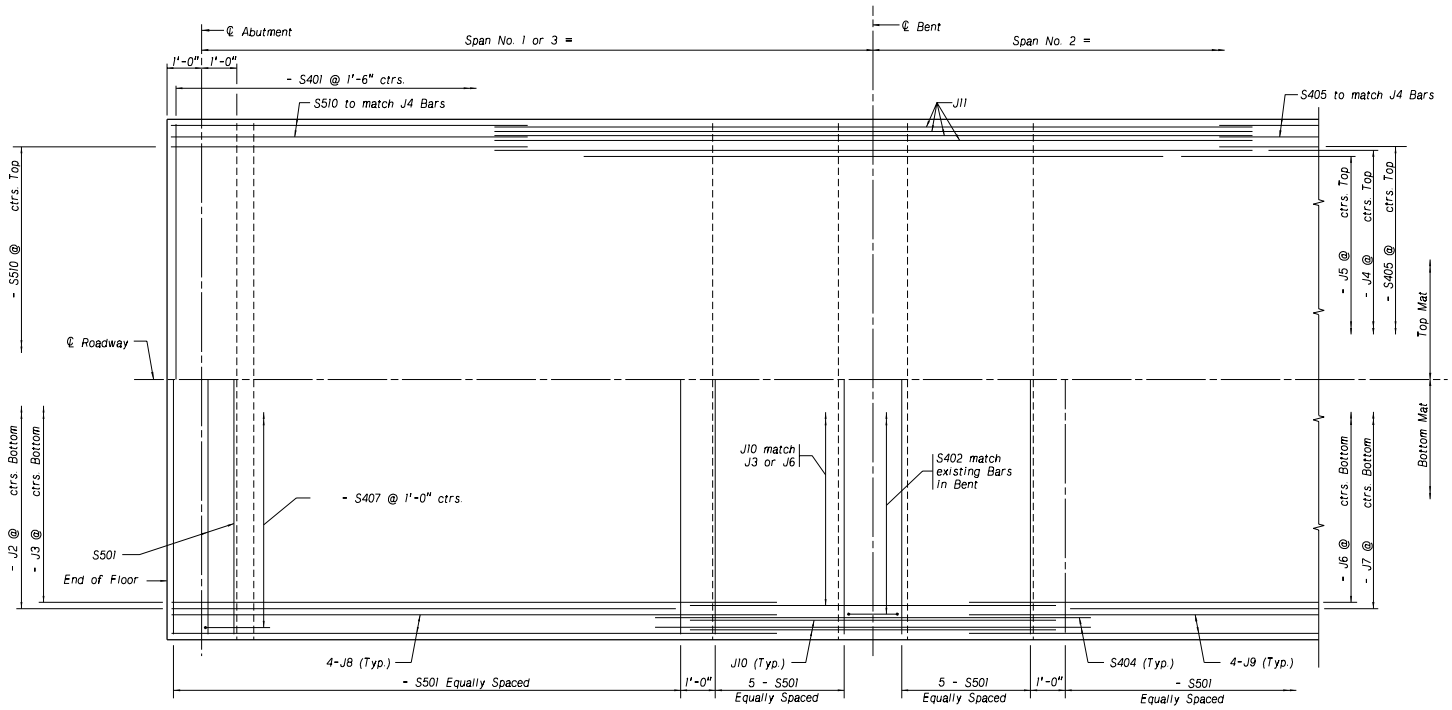
SLABRGCTE3.DGN

Feb. 12, 2004

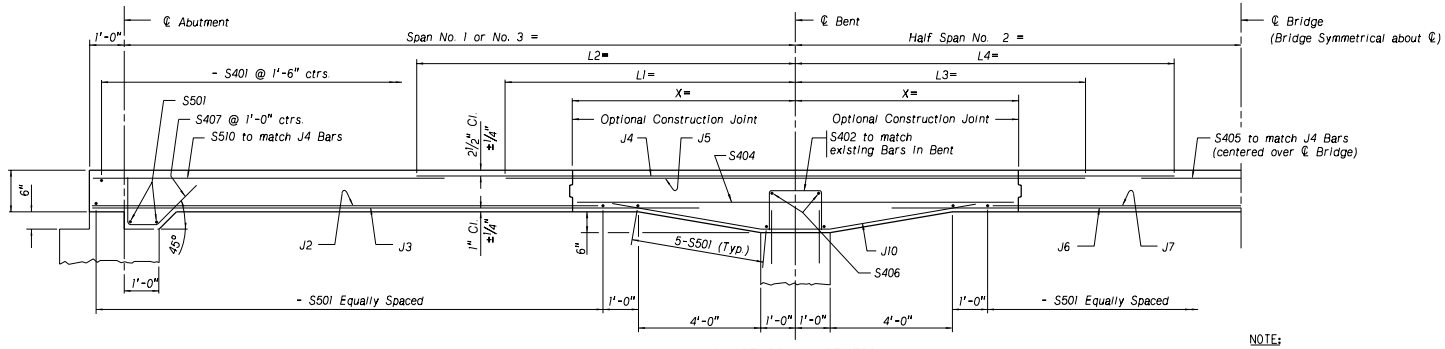
Sheet A

* Shown on this page

* LEVEL 42 = 40 ft. (12.190m) to 90 ft. (27.432m) bridge
LEVEL 43 = 90 ft. (27.432m) to 140 ft. (42.670m) bridge



SLAB REINFORCEMENT LAYOUT
Not to Scale



LONGITUDINAL SECTION
Not to Scale

NOTE;
When the falsework is removed, the anticipated slab deflection will be .001' for each Foot of clear span or fraction thereof.

For Construction Joint Detail See Sheet of .

PROJECT NUMBER | SHEET NO.

C.N.
STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.2.2

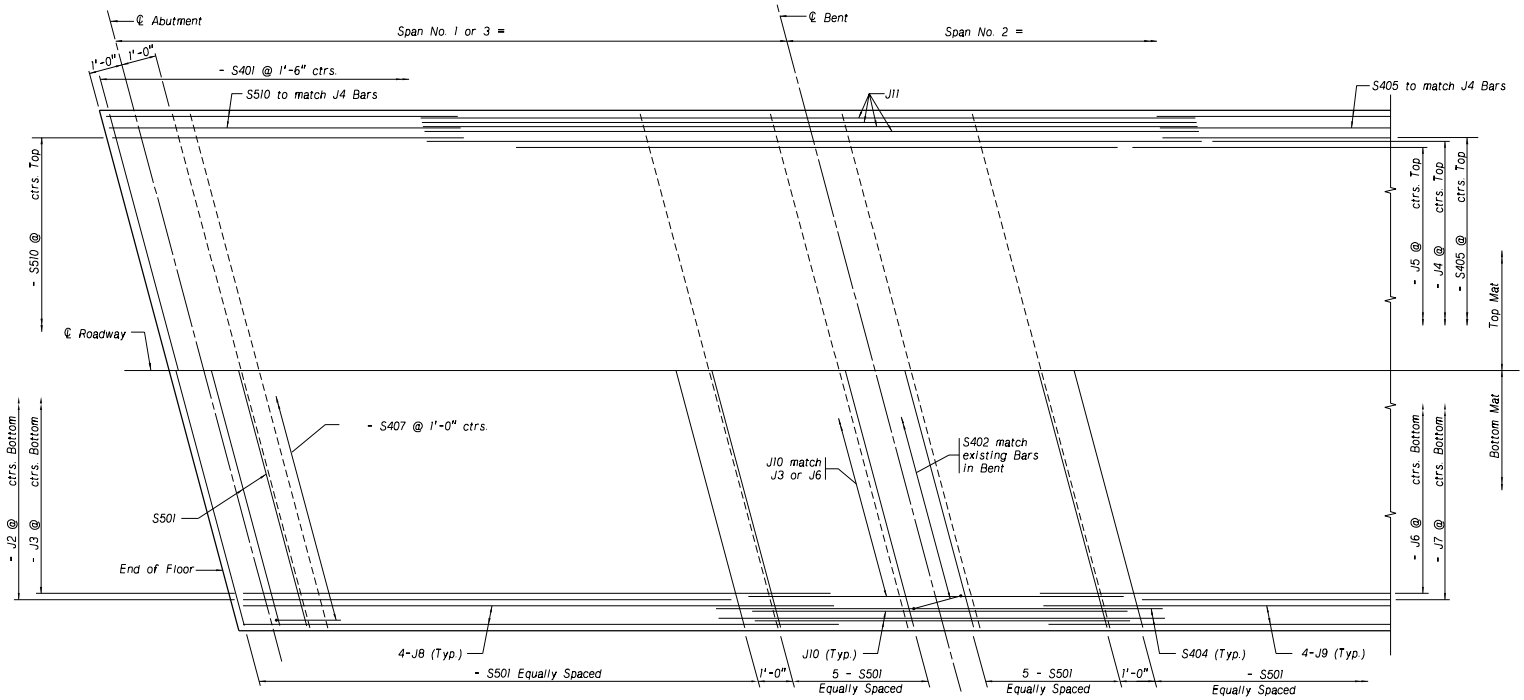
SLABRGCTE3.DGN

Feb. 12, 2004

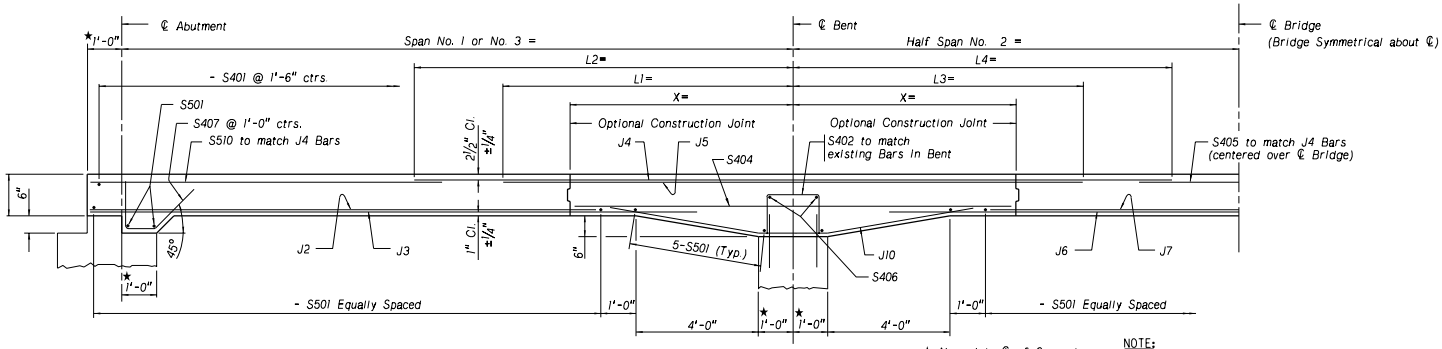
Sheet B

* *Shown on this page*

* LEVEL 42 = 40 ft. (12.190m) to 90 ft. (27.432m) bridge
LEVEL 43 = 90 ft. (27.432m) to 140 ft. (42.670m) bridge



SLAB REINFORCEMENT LAYOUT
Not to Scale



LONGITUDINAL SECTION
Not to Scale

★ Normal to ℄ of Support

NOTE;
When the falsework is removed, the anticipated slab deflection will be .001' for each Foot of clear span or fraction thereof.

For Construction Joint Detail See Sheet of .

PROJECT NUMBER | SHEET NO.

C.N.
STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE
DESIGNED BY
COUNTY
HWY. NO.
REF. POST.
STA.

Nebraska

SPECIAL PLAN NO.

6.2.3

SLABRGCTE3.DGN

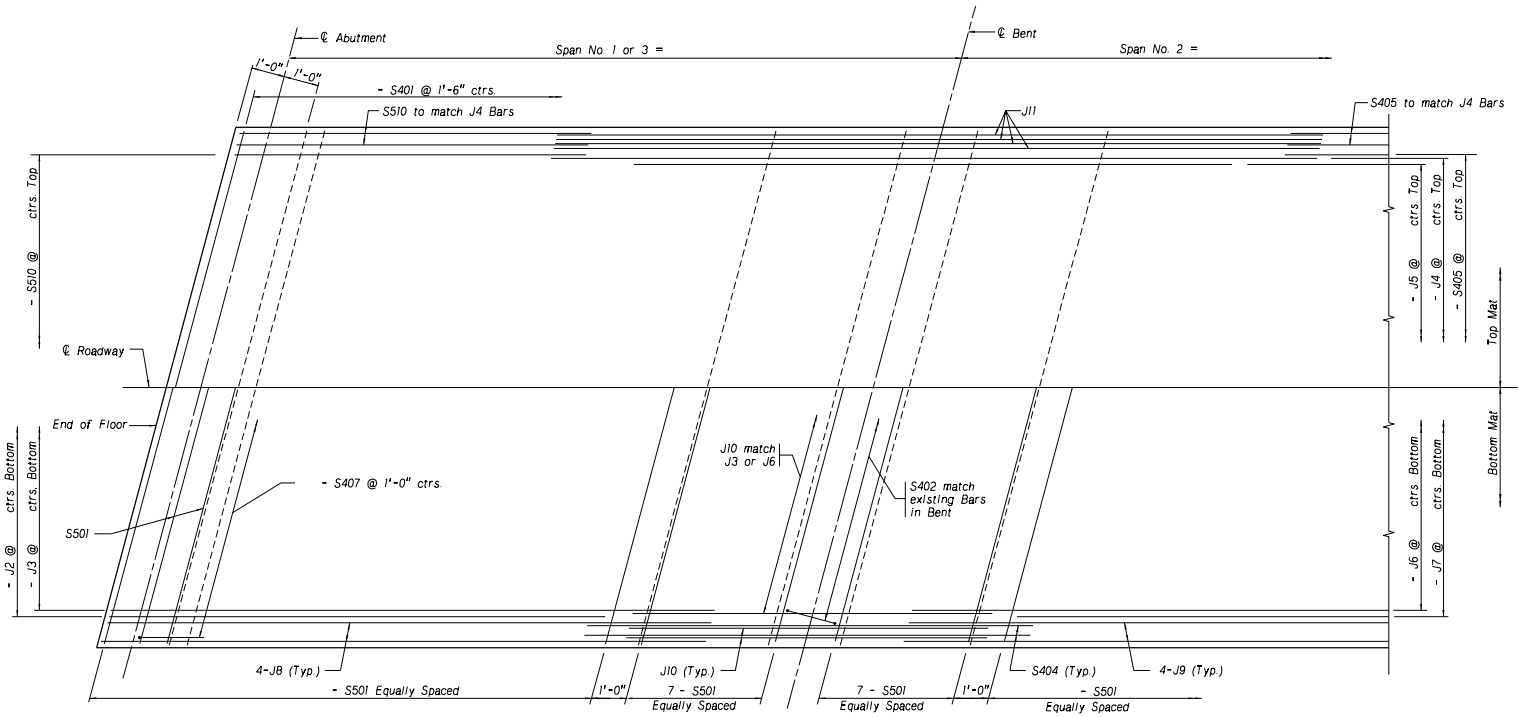
Feb. 12, 2004

Sheet 3

* *Shown on this page*

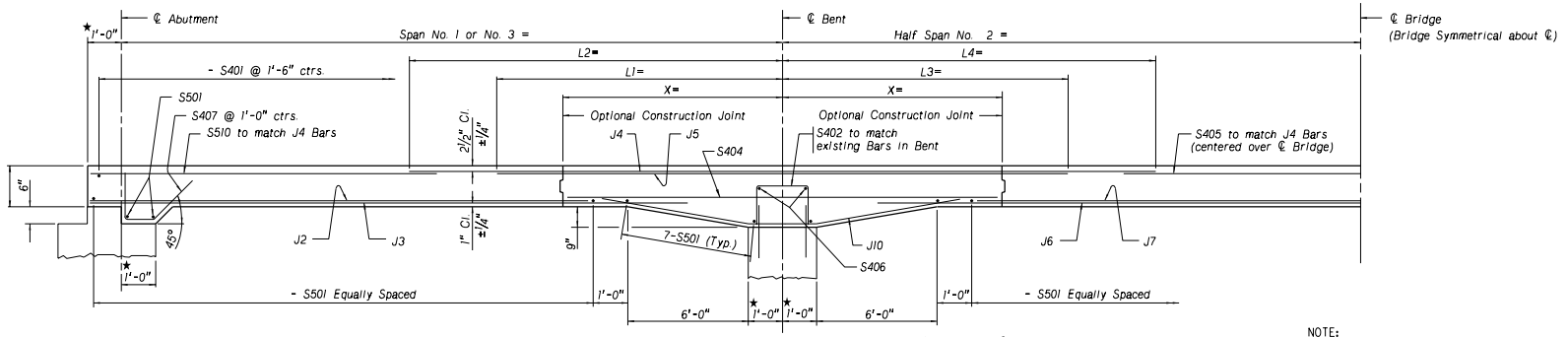
LEVEL 55 = 40 ft. (12.190m) to 90 ft. (27.432m) bridge

* LEVEL 56 = 90 ft. (27.432m) to 140 ft. (42.670m) bridge



SLAB REINFORCEMENT LAYOUT

Not to Scale



LONGITUDINAL SECTION

Not to Scale

★ Normal to ℄ of Support

NOTE;

When the falsework is removed, the anticipated slab deflection will be .001' for each Foot of clear span or fraction thereof.

For Construction Joint Detail See Sheet of .

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.2.4

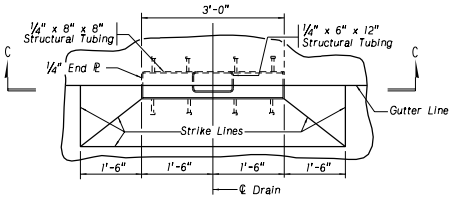
SLABRGCTE3.DGN

Feb. 12, 2004

Sheet of

* Shown on this page

*LEVEL 50 = Galvanized Floor Drain
LEVEL 51 = Painted Floor Drain
*LEVEL 52 = Standard Inlet
LEVEL 53 = Offset Inlet



PLAN

FLOOR DRAIN NOTES

Strike lines may vary to fit conditions.

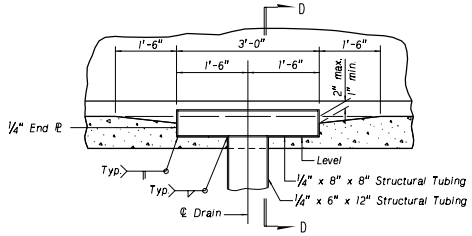
Field bend or cut reinforcing steel to clear floor drain a minimum of 1".

Set floor drains level.

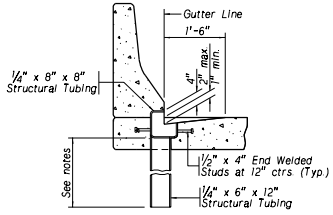
Structural Tubing shall meet the requirements of ASTM A500, Grade B.

The bottom of the 12" x 6" structural tubing (down spout) shall extend 1" below bottom flange of the girder.

All floor drains shall be galvanized in accordance with ASTM A153



SECTION C-C



SECTION D-D

FLOOR DRAIN DETAILS

Not to Scale

PROJECT NUMBER	SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREIMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

COUNTY
HWY. NO.
REF. POST.
STA.

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

DESIGNED BY
DETAILED BY
CHECKED BY
DATE

Nebraska

SPECIAL PLAN NO.

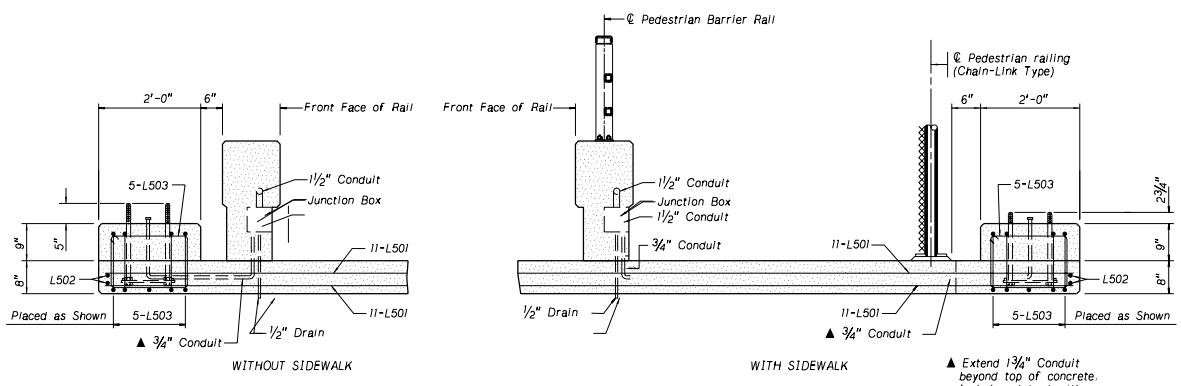
6.2.5

FLRDRNCTE.DGN

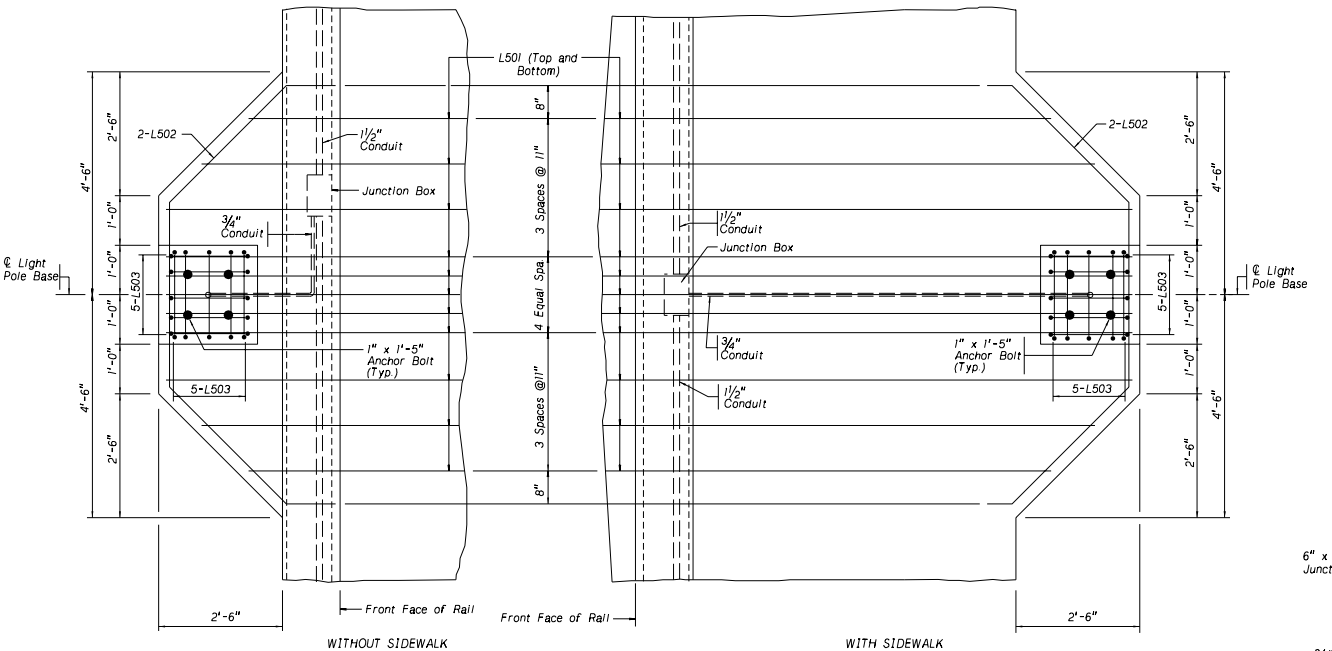
Sheet A

* *Shown on this page*

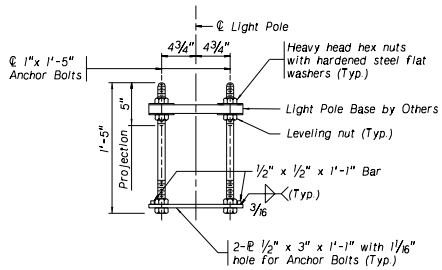
* LEVEL 50 = Concrete Rail
LEVEL 51 = 2'-8" Concrete Barrier
LEVEL 52 = 3'-6" Concrete Barrier



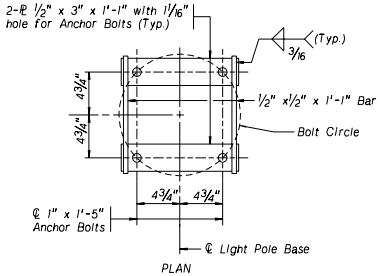
CROSS SECTION OF LIGHT POLE STANDARD BASE



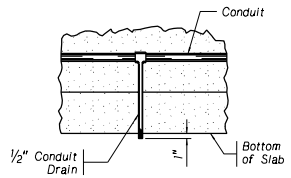
PLAN OF LIGHT POLE STANDARD BASE



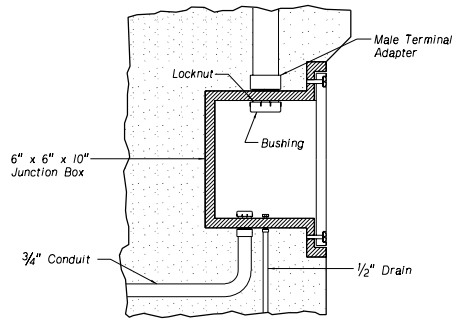
ELEVATION



ANCHOR BOLT LAYOUT FOR LIGHT POLE



CONDUIT DRAIN



JUNCTION BOX

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER — LYMAN D. FREEMON E-2005 — STATE OF NEBRASKA

BRIDGE ENGINEER

LIGHT POLE BASE

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

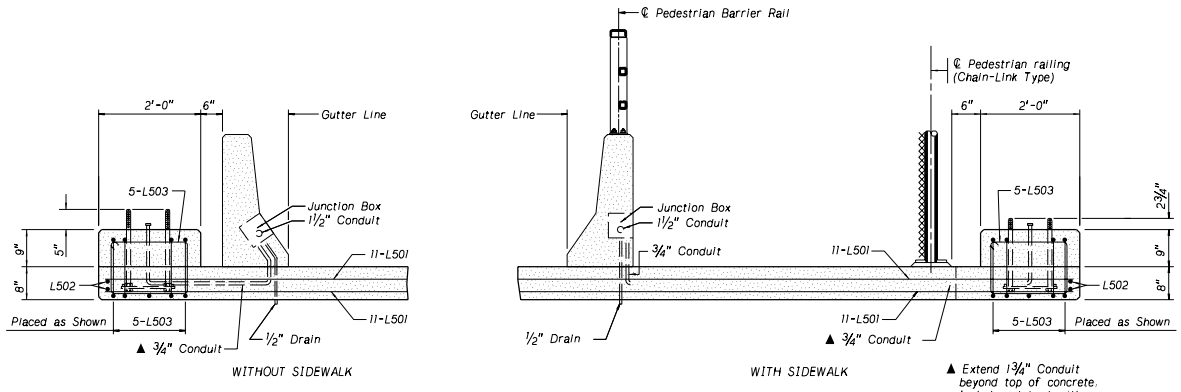
9.2.9

LIGHTCTE2.DGN

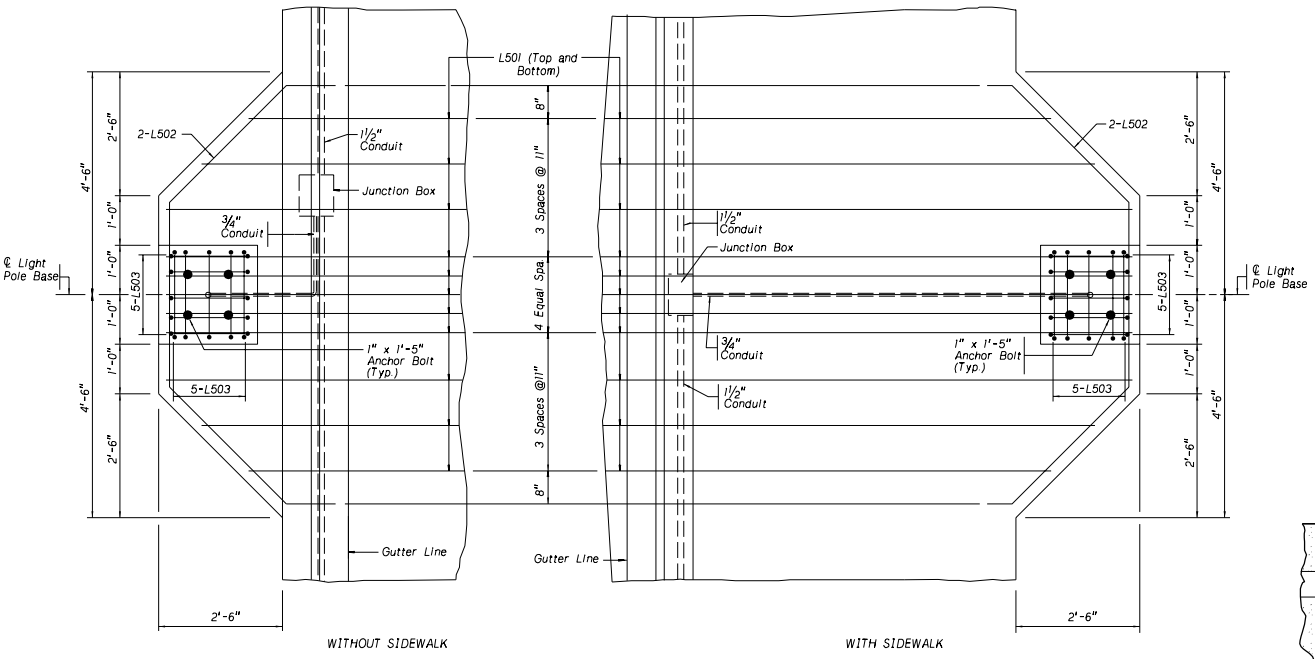
Sheet A

* *Shown on this page*

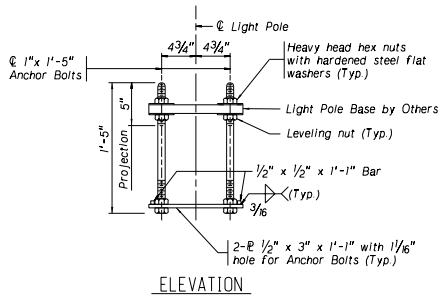
LEVEL 50 = Concrete Rail
* LEVEL 51 = 2'-8" Concrete Barrier
LEVEL 52 = 3'-6" Concrete Barrier



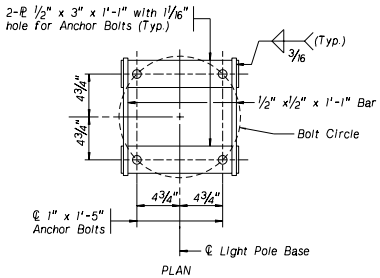
CROSS SECTION OF LIGHT POLE STANDARD BASE



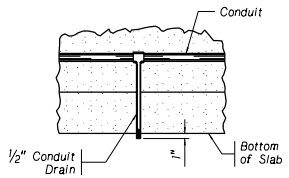
PLAN OF LIGHT POLE STANDARD BASE



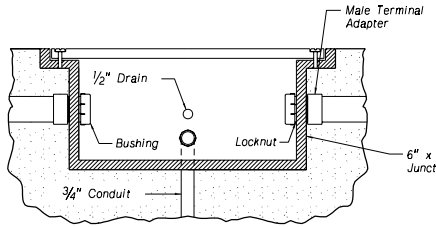
ELEVATION



ANCHOR BOLT LAYOUT FOR LIGHT POLE



CONDUIT DRAIN



JUNCTION BOX

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 — PROFESSIONAL STRUCTURAL ENGINEER — STATE OF NEBRASKA

BRIDGE ENGINEER

LIGHTCTE2.DGN

LIGHT POLE BASE

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

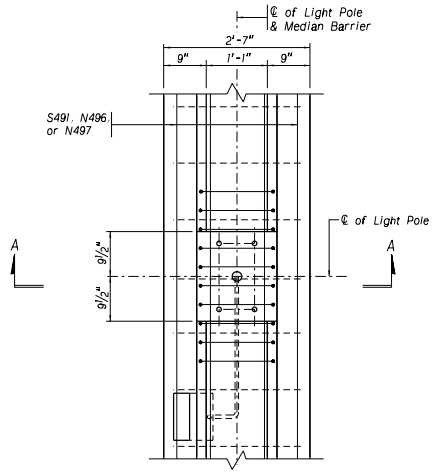
SPECIAL PLAN NO.

Sheet A

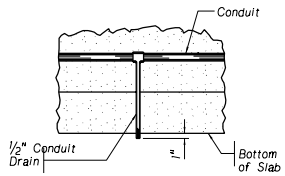
6.2.7

* *Shown on this page*

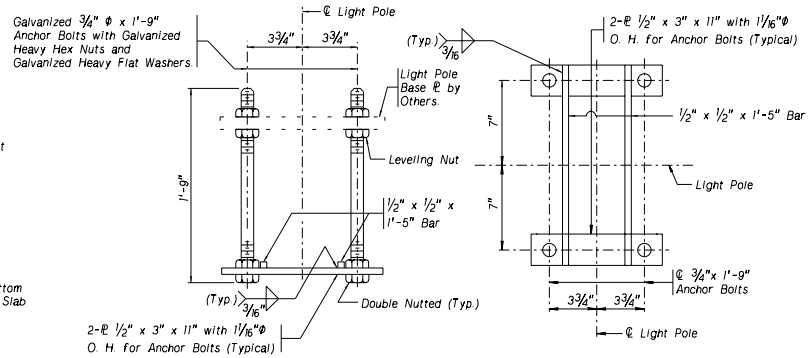
LEVEL 50 = Concrete Rail
LEVEL 51 = 2'-8" Concrete Barrier
* LEVEL 52 = 3'-6" Concrete Barrier



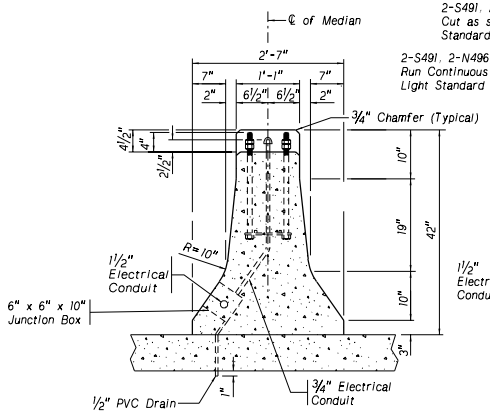
PLAN OF STANDARD BASE ON MEDIAN BARRIER



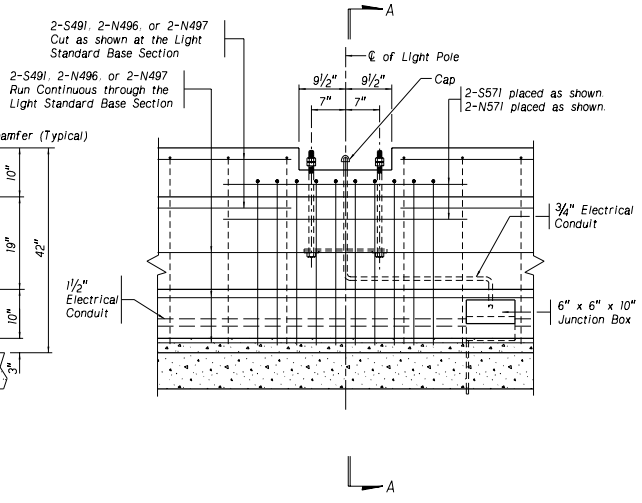
CONDUIT DRAIN



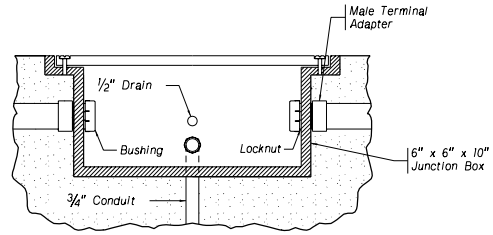
ANCHOR BOLT LAYOUT FOR LIGHT POLE (ON MEDIAN BARRIER ONLY)



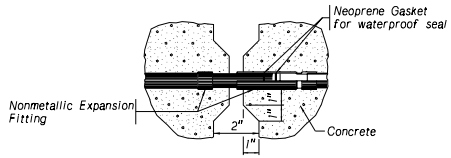
SECTION A-A



ELEVATION OF LIGHT STANDARD BASE ON MEDIAN BARRIER



JUNCTION BOX



EXPANSION FITTING (4" Min. Movement)

LIGHTCTE.DGN

Sheet C

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER LYMAN D. FREEMON E-2005 STATE OF NEBRASKA

BRIDGE ENGINEER

LIGHT STANDARD BASE AND MEDIAN BARRIER DETAILS

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE
COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

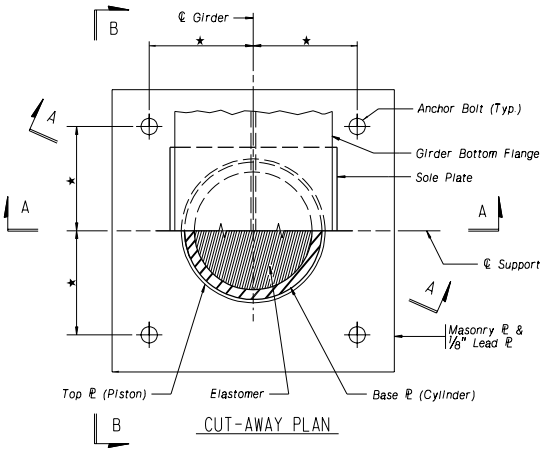
9.2.8

* Shown on this page

*LEVEL 50 = NO SKEW
LEVEL 51 = SKEWED GIRDER - BOLTS PARALLEL TO SUPPORT
LEVEL 52 = NO BEVELED SOLE PLATE
*LEVEL 53 = BEVELED SOLE PLATE

POTCTE.DGN

PROJECT NUMBER	SHEET NO.



CUT-AWAY PLAN

BOTTOM OF GIRDER BOTTOM FLANGE ELEVATIONS AT x BEARINGS

LOCATION	GIRDER "A"	GIRDER "B"	GIRDER "C"	GIRDER "D"	GIRDER "E"

CONFINED ELASTOMERIC BEARING DATA

Location	Capacity	Type	Min. Rotation	Total Movement	Beveled Sole ℄ X	Beveled Sole ℄ Y

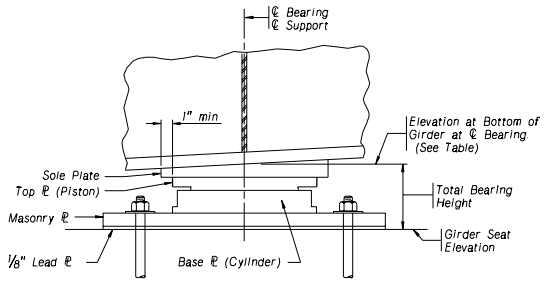
CONFINED ELASTOMERIC BEARING NOTES

Bearing devices and masonary plates shall conform to the Special Provisions and shall be designed by the manufacturer in accordance with the 16th edition of the AASHTO "Standard Specifications for Highway Bridges" and to include the subsequent interim specifications. Design computations shall be submitted with the shop plans.

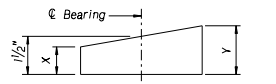
Sole plates must be 1½" thick and at least ¾" wider than the width of the girder bottom flange. The sole plate shall be 1" longer than the top ℄ along ℄ girder, and shop welded to the bearing top plate. The sole plate and/or bearing top plate shall be centered under the bearing stiffener. Sole plates shall be subsidiary to the Item "Bearing Devices".

* Anchor bolts shall be located in such a manner as to provide sufficient horizontal clearance or a 2" minimum vertical clearance between the bolts and the bearing top plate and/or sole plate. All anchor bolts shall have a 6" minimum clearance to the nearest vertical concrete face. The anchor bolt layout and projection above the girder seat shall be as specified by the manufacturer. Furnishing and installing anchor bolts shall be subsidiary to the item "Bearing Devices".

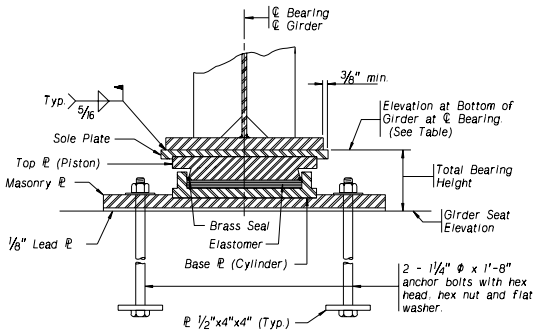
Girder seat elevations shall be calculated by the contractor, by subtracting the total bearing height furnished from the corresponding bottom of girder bottom flange elevations given in the table.



VIEW B-B

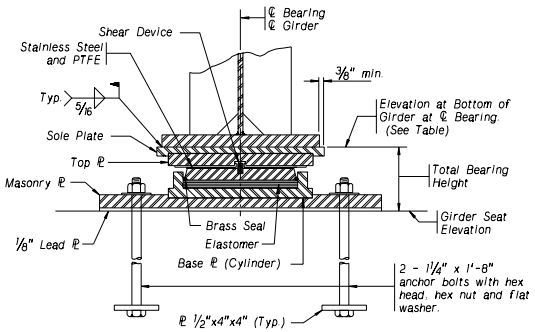


SECTION OF BEVELED SOLE PLATE



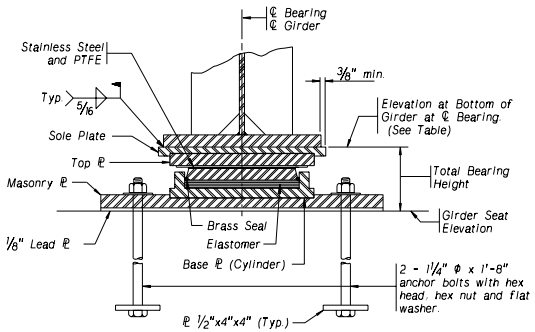
SECTION A-A

FIXED BEARING
TYPE I



SECTION A-A

GUIDED EXPANSION BEARING
TYPE II



SECTION A-A

NON-GUIDED EXPANSION BEARING
TYPE III

C.N.
STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 PROFESSIONAL STRUCTURAL ENGINEER STATE OF NEBRASKA

BRIDGE ENGINEER

CONFINED ELASTOMERIC BEARINGS

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.2.9

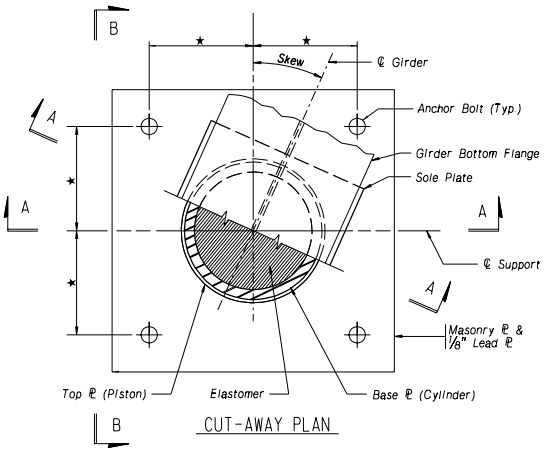
Sheet A

* *Shown on this page*

LEVEL 50 = NO SKEW
*LEVEL 51 = SKEWED GIRDER - BOLTS PARALLEL TO SUPPORT
*LEVEL 52 = NO BEVELED SOLE PLATE
LEVEL 53 = BEVELED SOLE PLATE

POTCTE.DGN

PROJECT NUMBER	SHEET NO.



CUT-AWAY PLAN

BOTTOM OF GIRDER BOTTOM FLANGE ELEVATIONS AT × BEARINGS					
LOCATION	GIRDER "A"	GIRDER "B"	GIRDER "C"	GIRDER "D"	GIRDER "E"

CONFINED ELASTOMERIC BEARING DATA				
Location	*Capacity*	*Type*	*Min. Rotation*	*Total Movement*

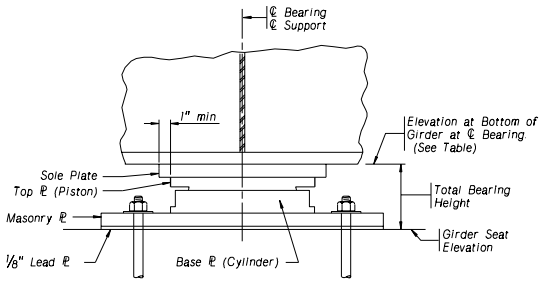
CONFINED ELASTOMERIC BEARING NOTES

Bearing devices and masonary plates shall conform to the Special Provisions and shall be designed by the manufacturer in accordance with the 16th edition of the AASHTO "Standard Specifications for Highway Bridges" and to include the subsequent interim specifications. Design computations shall be submitted with the shop plans.

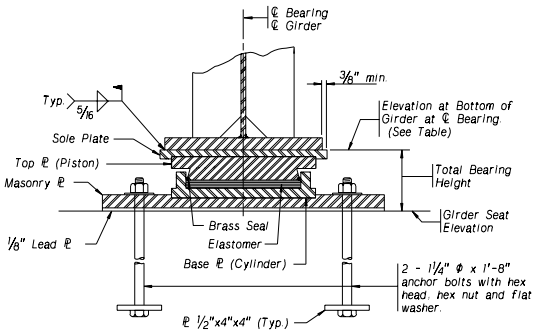
Sole plates must be 1½" thick and at least ¾" wider than the width of the girder bottom flange. The sole plate shall be 1" longer than the top ℄ along ℄ girder, and shop welded to the bearing top plate. The sole plate and/or bearing top plate shall be centered under the bearing stiffener. Sole plates shall be subsidiary to the item "Bearing Devices".

★ *Anchor bolts shall be located in such a manner as to provide sufficient horizontal clearance or a 2" minimum vertical clearance between the bolts and the bearing top plate and/or sole plate. All anchor bolts shall have a 6" minimum clearance to the nearest vertical concrete face. The anchor bolt layout and projection above the girder seat shall be as specified by the manufacturer. Furnishing and installing anchor bolts shall be subsidiary to the item "Bearing Devices".*

Girder seat elevations shall be calculated by the contractor, by subtracting the total bearing height furnished from the corresponding bottom of girder bottom flange elevations given in the table.

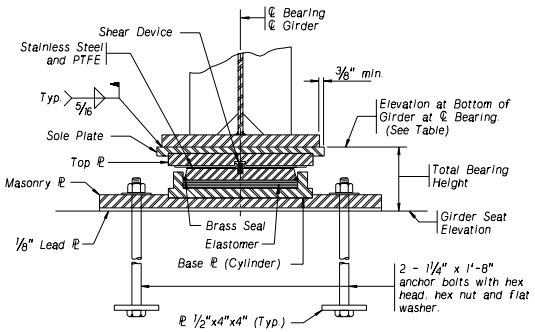


VIEW B-B



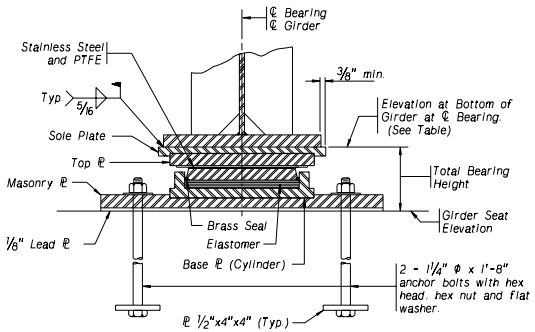
SECTION A-A

FIXED BEARING
TYPE I



SECTION A-A

GUIDED EXPANSION BEARING
TYPE II



SECTION A-A

NON-GUIDED EXPANSION BEARING
TYPE III

C.N.
STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 PROFESSIONAL STRUCTURAL ENGINEER STATE OF NEBRASKA

BRIDGE ENGINEER

CONFINED ELASTOMERIC BEARINGS

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DESIGNED BY
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

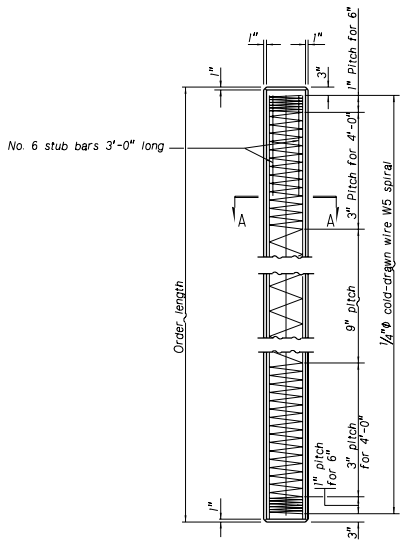
Nebraska

SPECIAL PLAN NO.

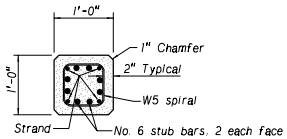
Sheet A

6.2.10

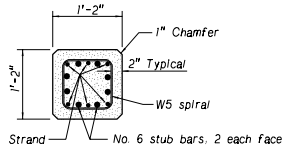
LEVEL 40 = CAST-IN-PLACE CONCRETE PILE



TYPE I, II, AND IV ELEVATION

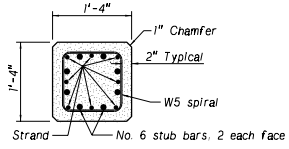


TYPE I
SECTION A-A

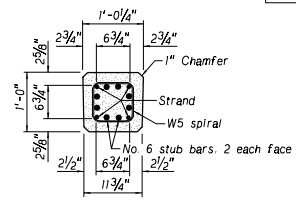


TYPE II
SECTION A-A

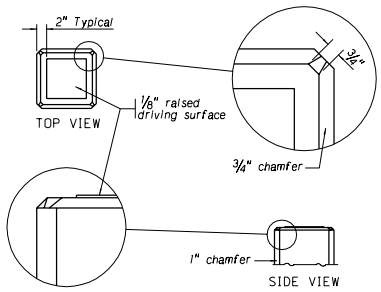
Note: Type III not used.



TYPE IV
SECTION A-A

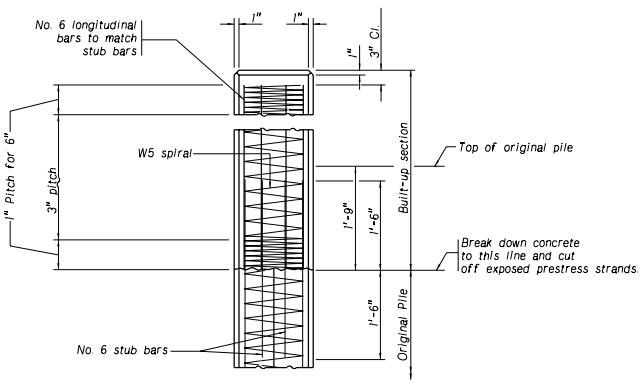


ALTERNATE TO TYPE I
SECTION A-A



ALTERNATE PILE TOP

Note:
The clearance from face of concrete to surface of prestress strand is 2 1/4" and clearance from face of concrete to surface of spiral is 2".



TYPICAL ELEVATION - PILE BUILT-UP

- NOTES -

Prestressing strands shall be uncoated, seven wire, stress relieved or low relaxation steel strand of nominal 1/2" diameter and shall conform to the requirements of ASTM A416, Grade 270.

Each strand shall be tensioned to an initial prestress force of 28,910 lbs..

All methods employed and procedures to be followed in tensioning the strands shall be subject to the approval of the engineer.

Extreme care shall be exercised in lifting, handling and storage of the piles to prevent cracking or damage.

Deformed reinforcing bars shall conform to the requirements of ASTM A615/A615M, Grade 60.

Wire for spiral reinforcement shall conform to the requirements of ASTM A82.

All concrete for prestressed concrete bearing piles shall be Class 47B-P or 47B-PHE with a minimum 28 day compressive strength of 5000 Psi.

WEIGHT OF PILE		
TYPE	SIZE	WEIGHT LBS./FT.
I	12	148
II	14	200
IV	16	263

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.3.1

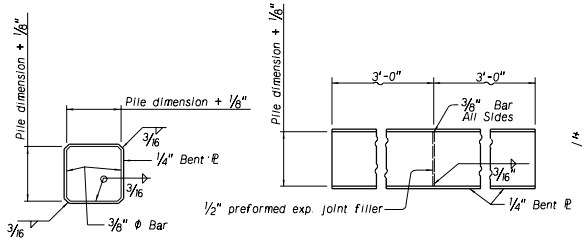
CONCPILCTEI.DGN

Feb. 12, 2004

Sheet 4

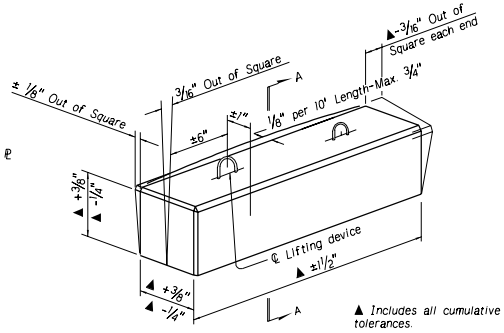
TYPE I, II & IV										
PILE LENGTH "L"	ONE POINT PICK-UP			TWO POINT PICK-UP			FOUR POINT PICK-UP			
	A	B	DIA	A & C	B	DIA	A & C	B	D & E	DIA
20'-0"	5'-10"	14'-2"	A	4'-2"	11'-8"	B	———	———	———	———
25'-0"	7'-4"	17'-8"	A	5'-2"	14'-8"	B	———	———	———	———
30'-0"	8'-9"	21'-3"	A	6'-3"	17'-6"	B	———	———	———	———
35'-0"	10'-3"	24'-9"	A	7'-3"	20'-6"	B	———	———	———	———
40'-0"	———	———	—	8'-3"	23'-6"	B	———	———	———	———
45'-0"	———	———	—	9'-4"	26'-4"	B	———	———	———	———
50'-0"	———	———	—	10'-4"	29'-4"	B	———	———	———	———
55'-0"	———	———	—	11'-5"	32'-2"	B	———	———	———	———
60'-0"	———	———	—	12'-5"	35'-2"	B	———	———	———	———
65'-0"	———	———	—	13'-5"	38'-2"	B	———	———	———	———
70'-0"	———	———	—	———	———	—	12'-0"	26'-0"	10'-0"	C
75'-0"	———	———	—	———	———	—	12'-0"	31'-0"	10'-0"	C
80'-0"	———	———	—	———	———	—	14'-0"	32'-0"	10'-0"	C
85'-0"	———	———	—	———	———	—	14'-0"	37'-0"	10'-0"	C
90'-0"	———	———	—	———	———	—	14'-0"	32'-0"	15'-0"	C
95'-0"	———	———	—	———	———	—	14'-0"	35'-0"	16'-0"	C
100'-0"	———	———	—	———	———	—	14'-0"	35'-0"	18'-6"	C

NOTE: LIFT SHALL BE VERTICAL



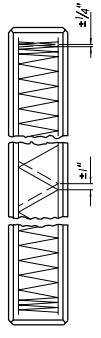
** PILE SPLICE FOR PRESTRESSED CONCRETE PILE

** Pile splices shall only be used in accordance with the special plans or the special provisions.

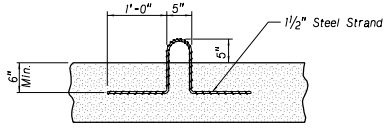


▲ Includes all cumulative tolerances.

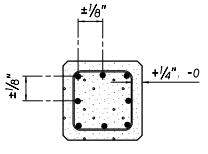
PILE TOLERANCES



SPIRAL LOCATION TOLERANCES



LIFTING DEVICE



SECTION A-A

Note:
Lifting devices shall be cut off after pile is placed in leads. Cutting of the lifting device will not be paid for directly but will be considered subsidiary to items for which payment is made.

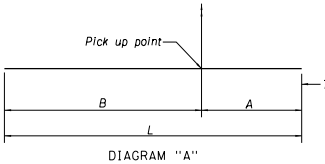


DIAGRAM "A"

ONE POINT PICK UP

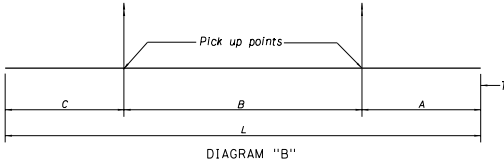


DIAGRAM "B"

TWO POINT PICK UP

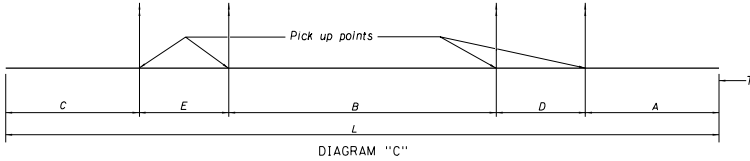


DIAGRAM "C"

FOUR POINT PICK UP

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER — LYMAN D. FREEMON E-2005 — STATE OF NEBRASKA

BRIDGE ENGINEER

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
DESIGNED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.3.2

CONCPILCTEI.DGN

Feb. 12, 2004

Sheet 8

LEVEL 39 = NU 900
* LEVEL 40 = NU 1100
LEVEL 41 = NU 1350
LEVEL 42 = NU 1600
LEVEL 43 = NU 1800
LEVEL 44 = NU 2000

* Shown on this page

* LEVEL 45 = Deflected Strand
LEVEL 46 = Debonded Strand
* LEVEL 47 = LHB Skewed End
LEVEL 48 = Zero Skew Ends
LEVEL 49 = RHB Skewed Ends
LEVEL 50 = Intermediate Diaphragms required

NUBRE1E3.DGN

NU 1100 GIRDER DESIGN

SPAN NO.	GIRDER CASTING LENGTH (Ft.)	CONCRETE STRENGTH (PSI) AT RELEASE	CONCRETE STRENGTH (PSI) AT 28 DAYS	NO. OF STRANDS PER GIRDER	STRANDS PER ROW AT MIDSPAN R1	R2	R3	R4	R5	R6	NUMBER of DEFLECTED STRANDS	STRAND CENTROID ENDS YE	STRAND CENTROID MIDSPAN YM	STRAND DEFLECTION AT ENDS YD	DISTANCE BETWEEN HOLDDOWN PNTS. X	BLOCK OUT DIMENSIONS Abut. B1	Piers B2

NON-COMPOSITE PROPERTIES

GIRDER MASS (Lbs/Ft)	GIRDER AREA (in^2)	GIRDER CENTROID YNC	MOMENT of INERTIA (in^4)	MIDSPAN CAMBER AT RELEASE	MIDSPAN CAMBER AT 30 DAYS	DEFLECTION FOR SHIMS (Due to Slab) Span Tenth Points (Sym.) .1	.2	.3	.4	.5

COMPOSITE PROPERTIES

WHEEL FACTOR	LANE FACTOR	SLAB 28 DAY Strength (PSI)	SLAB Design DEPTH	Midspan Transformed Concrete Section: SLAB Eff. WIDTH (n x b_e)	SECTION AREA (in^2)	SECTION CENTROID YC	MOMENT of INERTIA (in^4)	▲ SUPER-IMPOSED DEAD LOADS

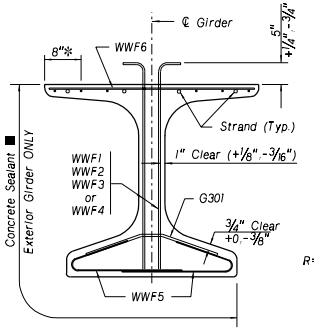
PROJECT NUMBER | SHEET NO.

C.N.

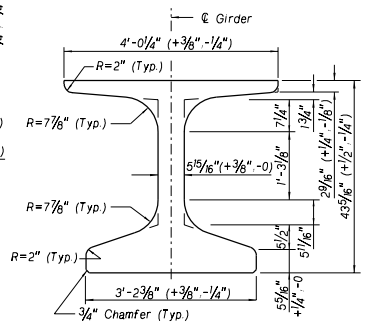
STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 — PROFESSIONAL STRUCTURAL ENGINEER — STATE OF NEBRASKA

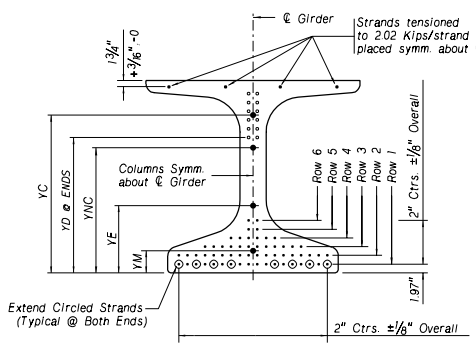
BRIDGE ENGINEER



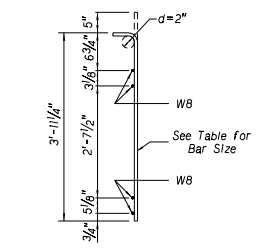
REINFORCING



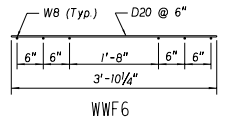
DIMENSIONS



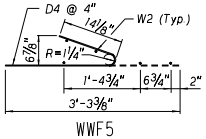
STRAND SPACINGS AND TOLERANCES



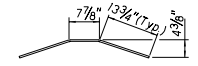
WWF1, WWF2, WWF3, & WWF4



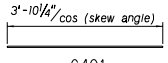
WWF6



WWF5

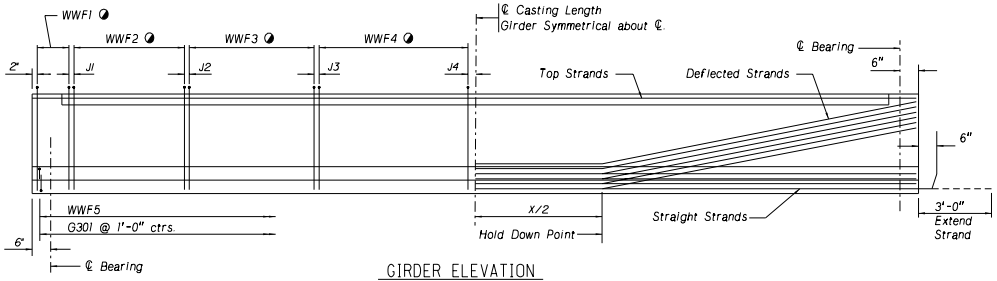


G301



G401

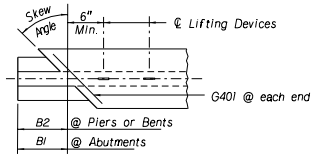
BENDING DIAGRAMS



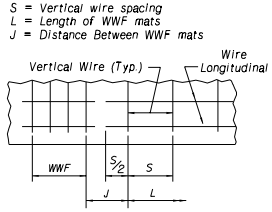
GIRDER ELEVATION

WELDED WIRE FABRICS (WWF5 & WWF6 as shown in Bending Diagrams)

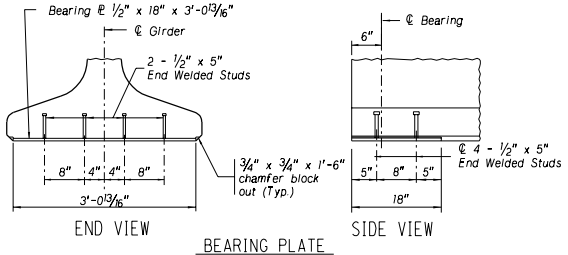
SPAN NO.	WWF1 BAR SIZE	S1	L1	J1	WWF2 BAR SIZE	S2	L2	J2	WWF3 BAR SIZE	S3	L3	J3	WWF4 BAR SIZE	S4	L4	J4
		2"	1'-0"		DI8	4"			DI8	8"			DI8	1'-0"		
		2"	1'-0"		DI8	4"			DI8	8"			DI8	1'-0"		
		2"	1'-0"		DI8	4"			DI8	8"			DI8	1'-0"		
		2"	1'-0"		DI8	4"			DI8	8"			DI8	1'-0"		



TOP FLANGE BLOCK OUT DETAIL



FABRIC PLACEMENT DETAIL



BEARING PLATE

PRESTRESSED GIRDER NOTES:

FABRICATOR shall be responsible for exercising extreme care in lifting, handling, storing and transporting of the prestressed girders to prevent cracking or damage. Girders shall be maintained in an upright position and supported near the ends at all times. Proper support bearings shall be used to avoid twisting of the girders. Girders shall be lifted by devices designed by the fabricator.

PRESTRESSING STRAND shall be uncoated, seven-wire, low-relaxation steel strand of 0.6" nominal diameter, and shall conform to the requirements of ASTM A416, Grade 270. Strands shall be tensioned to 43.94 Kips before release, unless specified otherwise. All methods and procedures employed in tensioning the strands shall be subject to the Engineer's approval. The method chosen shall be executed in a manner to assure that both ends of all strands in the girder are uniformly tensioned. The prestressed strand shall be released in a manner that will minimize eccentricity.

CONCRETE in the girders shall be Class "47B-P" or "47B-PHE", with concrete strengths at stress transfer and at 28 days as shown in data table. No bond stress shall be transferred to the concrete nor the end anchorage released until the concrete has attained the specified strength. All exposed edges of girders, except at top and ends, shall be chamfered ¾".

■ *CONCRETE SEALANT shall be applied to the outside of the exterior girders, as shown. Sealant shall be SII-Act40, manufactured by Act Corporation, Stifel, manufactured by Nox-Crete or approved equal.*

* *GIRDER TOP FLANGE shall be steel troweled to a smooth finish for 8" at the edges, as shown. Bond breaker shall be applied to this region only. The center portion shall be rough finished by scarifying the surface transversely with a wire brush and no laitance shall remain on the surface.*

REINFORCING STEEL shall conform to the requirements of ASTM designation A615/A615M, Grade 60. Welded Wire Fabric (WWF) shall conform to the requirements of ASTM A497.

BEARING PLATES shall conform to the requirements of ASTM A709/A709M, Grade 36 or Grade 50W weathering steel. The Grade 36 steel shall be galvanized according to the requirements of ASTM A123/A123M.

Tolerances shall be in accordance with the Prestressed Concrete Institute manual.

▲ *For rating purpose only, superimposed dead loads do not include future wearing surface.*

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
COUNTY
HWY. NO.
REF. POST.
STA.

DESIGNED BY | DETAILED BY | CHECKED BY | DATE

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.4.1

Jan. 20, 2000 Rev. Feb. 12, 2004

Sheet A

LEVEL 39 = NU 900
LEVEL 40 = NU 1100
* LEVEL 41 = NU 1350
LEVEL 42 = NU 1600
LEVEL 43 = NU 1800
LEVEL 44 = NU 2000

* LEVEL 45 = Deflected Strand
LEVEL 46 = Debonded Strand
LEVEL 47 = LHB Skewed End
* LEVEL 48 = Zero Skew Ends
LEVEL 49 = RHB Skewed Ends
* LEVEL 50 = Intermediate Diaphragms required

* Shown on this page

NUDRE3E3.DGN

Jan. 20, 2000

Rev. Feb. 12, 2004

Sheet B

NU 1350 GIRDER DESIGN

SPAN NO.	GIRDER CASTING LENGTH (Ft.)	CONCRETE STRENGTH (PSI) AT RELEASE	CONCRETE STRENGTH (PSI) AT 28 DAYS	NO. OF STRANDS PER GIRDER	STRANDS PER ROW AT MIDSPAN R1	R2	R3	R4	R5	R6	NUMBER of DEFLECTED STRANDS	STRAND CENTROID ENDS YE	STRAND CENTROID MIDSPAN YM	STRAND DEFLECTION AT ENDS YD	DISTANCE BETWEEN HOLDDOWN PNTS. X	BLOCK OUT DIMENSIONS Abut. B1	Piers B2

NON-COMPOSITE PROPERTIES

GIRDER MASS (Lbs/Ft)	GIRDER AREA (in^2)	GIRDER CENTROID YNC	MOMENT of INERTIA (in^4)	MIDSPAN CAMBER AT RELEASE	MIDSPAN CAMBER AT 30 DAYS	DEFLECTION FOR SHIMS (Due to Slab) Span Tenth Points (Sym.) .1	.2	.3	.4	.5

COMPOSITE PROPERTIES

WHEEL FACTOR	LANE FACTOR	SLAB 28 DAY Strength (PSI)	SLAB Design DEPTH	Midspan Transformed Concrete Section: SLAB Eff. WIDTH (n x b_e)	SECTION AREA (in^2)	SECTION CENTROID YC	MOMENT of INERTIA (in^4)	▲ SUPER-IMPOSED DEAD LOADS

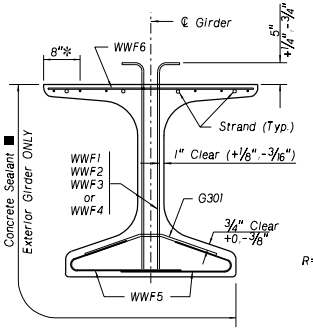
PROJECT NUMBER | SHEET NO.

C.N.

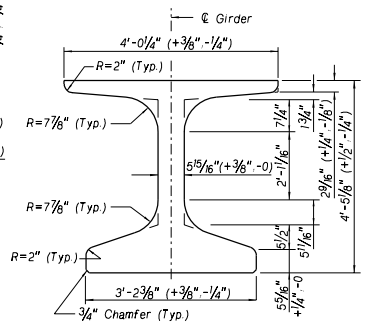
STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 — PROFESSIONAL STRUCTURAL ENGINEER — STATE OF NEBRASKA

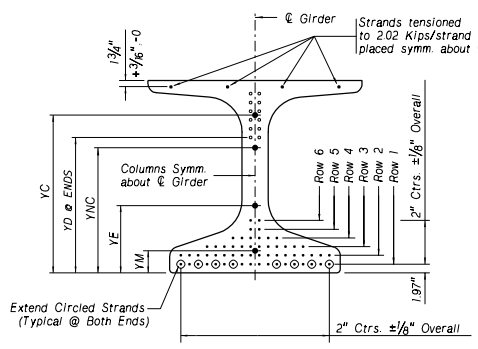
BRIDGE ENGINEER



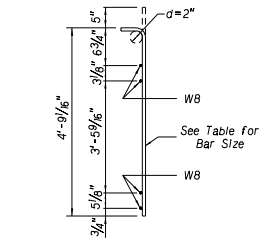
REINFORCING



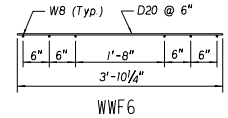
DIMENSIONS



STRAND SPACINGS AND TOLERANCES



WWF1, WWF2, WWF3, & WWF4



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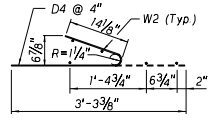
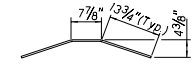


WWF5



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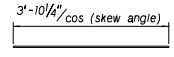
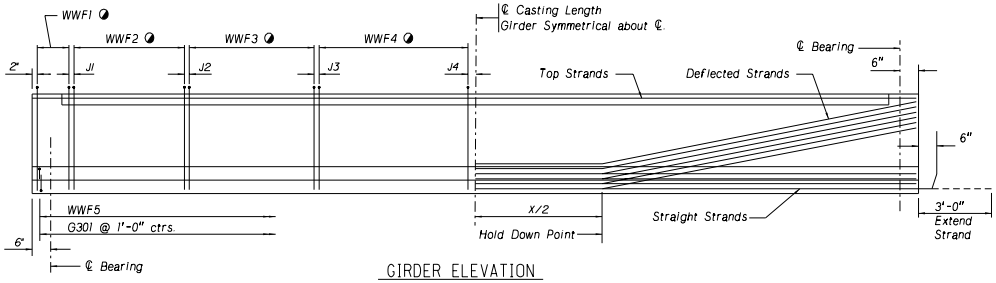
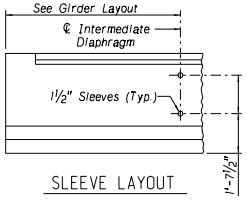


G401

BENDING DIAGRAMS



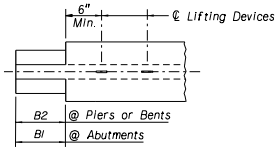
GIRDER ELEVATION



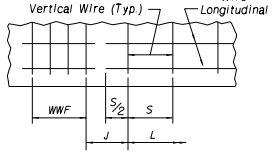
SLEEVE LAYOUT

◕ WELDED WIRE FABRICS (WWF5 & WWF6 as shown in Bending Diagrams)

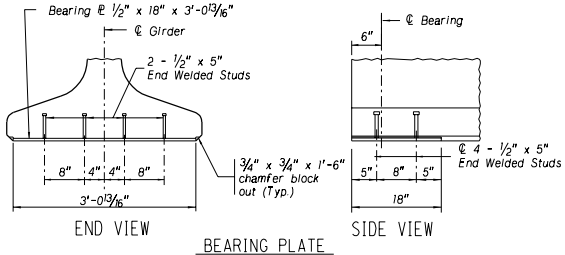
SPAN NO.	WWF1 BAR SIZE	S1	L1	J1	WWF2 BAR SIZE	S2	L2	J2	WWF3 BAR SIZE	S3	L3	J3	WWF4 BAR SIZE	S4	L4	J4
		2"	1'-0"		D18	4"			D18	8"			D18	1'-0"		
		2"	1'-0"		D18	4"			D18	8"			D18	1'-0"		
		2"	1'-0"		D18	4"			D18	8"			D18	1'-0"		
		2"	1'-0"		D18	4"			D18	8"			D18	1'-0"		



TOP FLANGE BLOCK OUT DETAIL



FABRIC PLACEMENT DETAIL



END VIEW

SIDE VIEW

BEARING PLATE

PRESTRESSED GIRDER NOTES:

FABRICATOR shall be responsible for exercising extreme care in lifting, handling, storing and transporting of the prestressed girders to prevent cracking or damage. Girders shall be maintained in an upright position and supported near the ends at all times. Proper support bearings shall be used to avoid twisting of the girders. Girders shall be lifted by devices designed by the fabricator.

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CONCRETE in the girders shall be Class "47B-P" or "47B-PHE", with concrete strengths at stress transfer and at 28 days as shown in data table. No bond stress shall be transferred to the concrete nor the end anchorage released until the concrete has attained the specified strength. All exposed edges of girders, except at top and ends, shall be chamfered ¾".

■ CONCRETE SEALANT shall be applied to the outside of the exterior girders, as shown. Sealant shall be Sil-Act40, manufactured by Act Corporation, Stifel, manufactured by Nox-Crete or approved equal.

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REINFORCING STEEL shall conform to the requirements of ASTM designation A615/A615M, Grade 60. Welded Wire Fabric (WWF) shall conform to the requirements of ASTM A497.

BEARING PLATES shall conform to the requirements of ASTM A709/A709M, Grade 36 or Grade 50W weathering steel. The Grade 36 steel shall be galvanized according to the requirements of ASTM A123/A123M.

Tolerances shall be in accordance with the Prestressed Concrete Institute manual.

▲ For rating purpose only, superimposed dead loads do not include future wearing surface.

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE
COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.4.2

LEVEL 39 = NU 900
LEVEL 40 = NU 1100
LEVEL 41 = NU 1350
* LEVEL 42 = NU 1600
LEVEL 43 = NU 1800
LEVEL 44 = NU 2000

LEVEL 45 = Deflected Strand
* LEVEL 46 = Debonded Strand
LEVEL 47 = LHB Skewed End
LEVEL 48 = Zero Skew Ends
* LEVEL 49 = RHB Skewed Ends
LEVEL 50 = Intermediate Diaphragms required

* Shown on this page

NU 1600 GIRDER DESIGN

SPAN NO.	GIRDER CASTING LENGTH (Ft.)	CONCRETE STRENGTH (PSI) AT RELEASE	CONCRETE STRENGTH (PSI) AT 28 DAYS	NO. OF STRANDS PER GIRDER	STRANDS PER ROW AT MIDSPAN R1	R2	R3	R4	R5	R6	NUMBER of DEBONDED STRANDS	STRAND CENTROID MIDSPAN YM	BLOCK OUT DIMENSIONS Abut. B1	Piers B2

NON-COMPOSITE PROPERTIES

GIRDER MASS (lbs/Ft)	GIRDER AREA (in^2)	GIRDER CENTROID YNC	MOMENT of INERTIA (in^4)	MIDSPAN CAMBER AT RELEASE	MIDSPAN CAMBER AT 30 DAYS	DEFLECTION FOR SHIMS (Due to Slab) Span Tenth Points (Sym.) .1	.2	.3	.4	.5

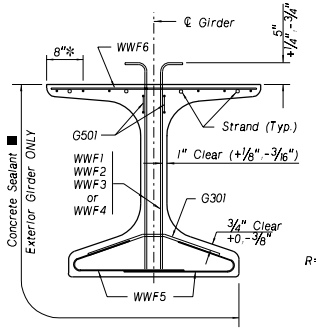
COMPOSITE PROPERTIES

WHEEL FACTOR	LANE FACTOR	SLAB 28 DAY Strength (PSI)	SLAB Design DEPTH (in)	Midspan Transformed Concrete Section: SLAB Eff. WIDTH (n x b_e)	SECTION AREA (in^2)	SECTION CENTROID YC	MOMENT of INERTIA (in^4)	Δ SUPER-IMPOSED DEAD LOADS

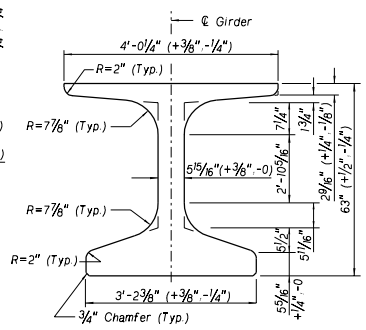
DEBONDED STRAND

Columns Sym. about ℄ Girder

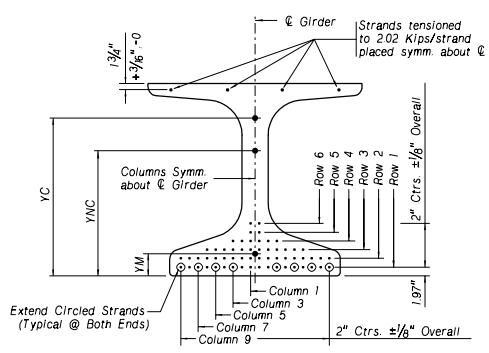
LOCATION ROW	LOCATION COLUMN	DEBONDING LENGTH
1		
2		
3		
4		



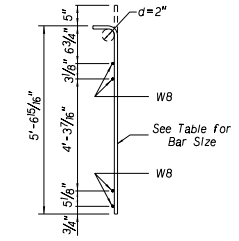
REINFORCING



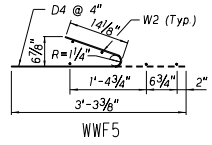
DIMENSIONS



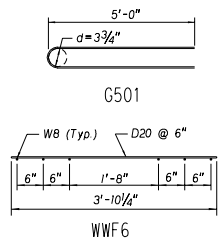
STRAND SPACINGS AND TOLERANCES



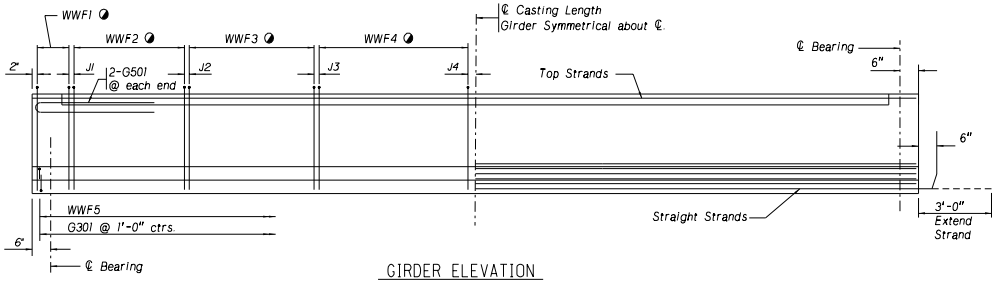
WWF1, WWF2, WWF3, & WWF4



WWF5



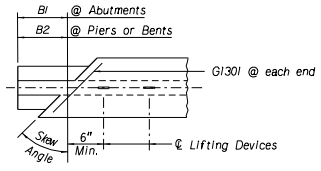
BENDING DIAGRAMS



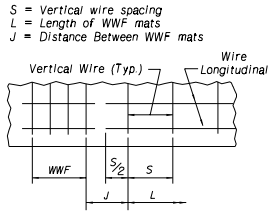
GIRDER ELEVATION

◕ WELDED WIRE FABRICS (WWF5 & WWF6 as shown in Bending Diagrams)

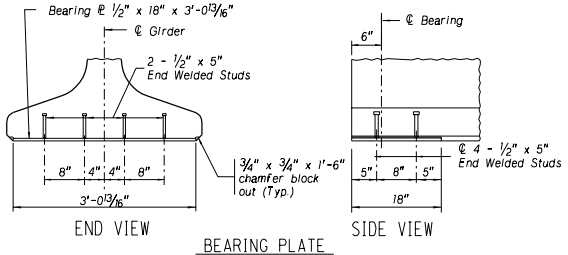
SPAN NO.	WWF1 BAR SIZE	S1	L1	J1	WWF2 BAR SIZE	S2	L2	J2	WWF3 BAR SIZE	S3	L3	J3	WWF4 BAR SIZE	S4	L4	J4
		2"	1'-0"		DI8	4"			DI8	8"			DI8	1'-0"		
		2"	1'-0"		DI8	4"			DI8	8"			DI8	1'-0"		
		2"	1'-0"		DI8	4"			DI8	8"			DI8	1'-0"		
		2"	1'-0"		DI8	4"			DI8	8"			DI8	1'-0"		



TOP FLANGE BLOCK OUT DETAIL



FABRIC PLACEMENT DETAIL



BEARING PLATE

PRESTRESSED GIRDER NOTES:

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* GIRDER TOP FLANGE shall be steel troweled to a smooth finish for 8" at the edges, as shown. Bond breaker shall be applied to this region only. The center portion shall be rough finished by scarifying the surface transversely with a wire brush and no laitance shall remain on the surface.

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Tolerances shall be in accordance with the Prestressed Concrete Institute manual.

Δ For rating purpose only, superimposed dead loads do not include future wearing surface.

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 — PROFESSIONAL STRUCTURAL ENGINEER — STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE
DESIGNED BY

COUNTY
HWY. NO.
REF. POST.
STA.

Nebraska

SPECIAL PLAN NO.

6.4.3

NUPRECTE3.DGN

Feb. 12, 2004

Sheet 3

LEVEL 39 = NU 900
LEVEL 40 = NU 1100
LEVEL 41 = NU 1350
LEVEL 42 = NU 1600
LEVEL 43 = NU 1800
* LEVEL 44 = NU 2000

LEVEL 45 = Deflected Strand
* LEVEL 46 = Debonded Strand
LEVEL 47 = LHB Skewed End
* LEVEL 48 = Zero Skew Ends
LEVEL 49 = RHB Skewed Ends
LEVEL 50 = Intermediate Diaphragms required

* Shown on this page

NU 2000 GIRDER DESIGN

SPAN NO.	GIRDER CASTING LENGTH (Ft.)	CONCRETE STRENGTH (PSI) AT RELEASE	CONCRETE STRENGTH (PSI) AT 28 DAYS	NO. OF STRANDS PER GIRDER	STRANDS PER ROW AT MIDSPAN R1	R2	R3	R4	R5	R6	NUMBER of DEBONDED STRANDS	STRAND CENTROID MIDSPAN YM	BLOCK OUT DIMENSIONS Abut. B1	Piers B2

NON-COMPOSITE PROPERTIES

GIRDER MASS (lbs/Ft)	GIRDER AREA (in^2)	GIRDER CENTROID YNC	MOMENT of INERTIA (in^4)	MIDSPAN CAMBER AT RELEASE	MIDSPAN CAMBER AT 30 DAYS	DEFLECTION FOR SHIMS (Due to Slab) Span Tenth Points (Sym.) .1	.2	.3	.4	.5

COMPOSITE PROPERTIES

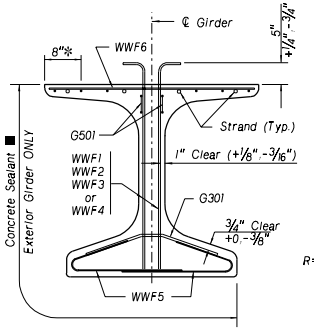
Midspan Transformed Concrete Section

WHEEL FACTOR	LANE FACTOR	SLAB 28 DAY Strength (PSI)	SLAB Design DEPTH (in)	SLAB Eff. WIDTH (n x b_e)	SECTION AREA (in^2)	SECTION CENTROID YC	SECTION MOMENT of INERTIA (in^4)	Δ SUPER-IMPOSED DEAD LOADS

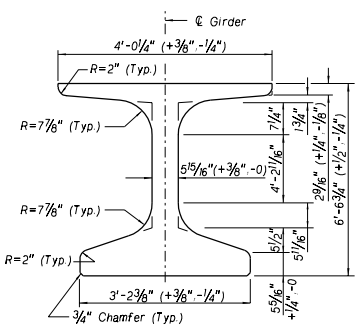
DEBONDED STRAND

Columns Sym. about ℄ Girder

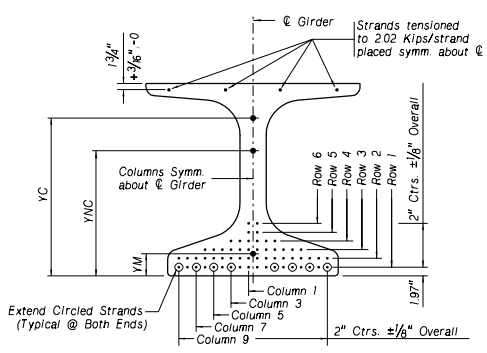
LOCATION ROW	LOCATION COLUMN	DEBONDING LENGTH
1		
2		
3		
4		



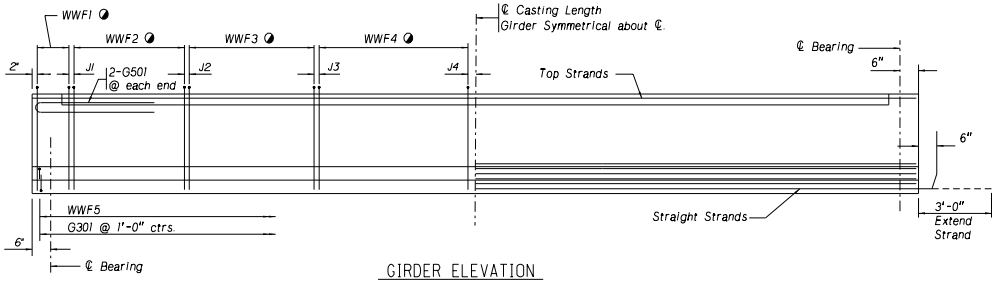
REINFORCING



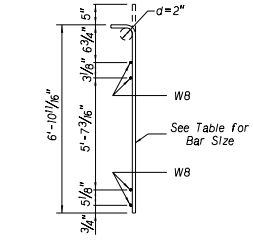
DIMENSIONS



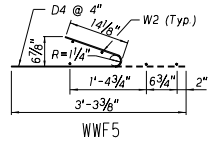
STRAND SPACINGS AND TOLERANCES



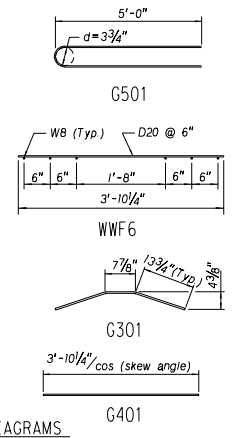
GIRDER ELEVATION



WWF1, WWF2, WWF3, & WWF4



WWF5

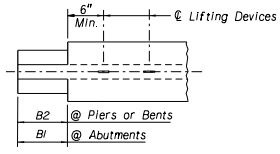


BENDING DIAGRAMS

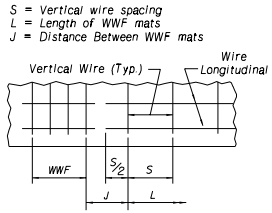
WELDED WIRE FABRICS

(WWF5 & WWF6 as shown in Bending Diagrams)

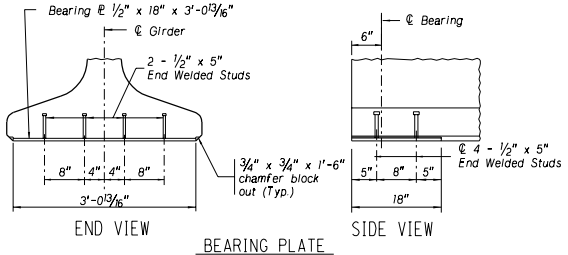
SPAN NO.	WWF1 BAR SIZE	S1	L1	J1	WWF2 BAR SIZE	S2	L2	J2	WWF3 BAR SIZE	S3	L3	J3	WWF4 BAR SIZE	S4	L4	J4
		2"	1'-0"		D18	4"			D18	8"			D18	1'-0"		
		2"	1'-0"		D18	4"			D18	8"			D18	1'-0"		
		2"	1'-0"		D18	4"			D18	8"			D18	1'-0"		
		2"	1'-0"		D18	4"			D18	8"			D18	1'-0"		



TOP FLANGE BLOCK OUT DETAIL



FABRIC PLACEMENT DETAIL



BEARING PLATE

PRESTRESSED GIRDER NOTES:

FABRICATOR shall be responsible for exercising extreme care in lifting, handling, storing and transporting of the prestressed girders to prevent cracking or damage. Girders shall be maintained in an upright position and supported near the ends at all times. Proper support bearings shall be used to avoid twisting of the girders. Girders shall be lifted by devices designed by the fabricator.

PRESTRESSING STRAND shall be uncoated, seven-wire, low-relaxation steel strand of 0.6" nominal diameter, and shall conform to the requirements of ASTM A416, Grade 270. Strands shall be tensioned to 43.94 Kips before release, unless specified otherwise. All methods and procedures employed in tensioning the strands shall be subject to the Engineer's approval. The method chosen shall be executed in a manner to assure that both ends of all strands in the girder are uniformly tensioned. The prestressed strand shall be released in a manner that will minimize eccentricity.

CONCRETE in the girders shall be Class "47B-P" or "47B-PHE", with concrete strengths at stress transfer and at 28 days as shown in data table. No bond stress shall be transferred to the concrete nor the end anchorage released until the concrete has attained the specified strength. All exposed edges of girders, except at top and ends, shall be chamfered ¾".

■ CONCRETE SEALANT shall be applied to the outside of the exterior girders, as shown. Sealant shall be Sil-Act40, manufactured by Act Corporation, Stifel, manufactured by Nox-Crete or approved equal.

* GIRDER TOP FLANGE shall be steel troweled to a smooth finish for 8" at the edges, as shown. Bond breaker shall be applied to this region only. The center portion shall be rough finished by scarifying the surface transversely with a wire brush and no laitance shall remain on the surface.

REINFORCING STEEL shall conform to the requirements of ASTM designation A615/A615M, Grade 60. Welded Wire Fabric (WWF) shall conform to the requirements of ASTM A497.

BEARING PLATES shall conform to the requirements of ASTM A709/A709M, Grade 36 or Grade 50W weathering steel. The Grade 36 steel shall be galvanized according to the requirements of ASTM A123/A123M.

Tolerances shall be in accordance with the Prestressed Concrete Institute manual.

Δ For rating purpose only, superimposed dead loads do not include future wearing surface.

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 — PROFESSIONAL STRUCTURAL ENGINEER — STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE
DESIGNED BY
COUNTY
HWY. NO.
REF. POST.
STA.

Nebraska

SPECIAL PLAN NO.

6.4.4

NUPRAELTE3.DGN

Jan. 20, 2000

Rev. Feb. 12, 2004

Sheet D

LEVEL 49 = 0° Skew
✻ LEVEL 50 = LHB under 15° Skew
LEVEL 51 = RHB under 15° Skew
LEVEL 52 = LHB over 15° Skew
LEVEL 53 = RHB over 15° Skew

✻ *Shown on this page*

✻ LEVEL 47 = 24.5" DEPTH
LEVEL 48 = 32.5" DEPTH

DOUBLE TEE DESIGN - 24.5" DEPTH

SPAN NO.	GIRDER CASTING LENGTH (Feet)	CONCRETE STRENGTH (MPa) AT RELEASE	CONCRETE STRENGTH (MPa) AT 28 DAYS	NO. OF STRANDS Per Column Col.1	NO. OF STRANDS Per Column Col.2	STRAND SPACING END SE1	SE2	SE3	SE4	SE5	MIDSPAN SM1	SM2	SM3	SM4	SM5	STRAND CENTROID ENDS YE	STRAND CENTROID MIDSPAN YM	DIST. BETWEEN HOLD DOWN POINTS, X	FLANGE DIMENSIONS F1	F2	F3
1																					
2																					
3																					

NON-COMPOSITE PROPERTIES

SPAN NO.	GIRDER MASS (lbs/Ft)	GIRDER AREA (in^2)	GIRDER CENTROID YNC	MOMENT of INERTIA (in^4)	MIDSPAN CAMBER AT RELEASE	MIDSPAN CAMBER AT 30 TO 60 DAYS	DEFLECTION FOR SHIMS (Due to Slab) Span Tenth Points (Sym.) .1	.2	.3	.4	.5
1											
2											
3											

COMPOSITE PROPERTIES

SPAN NO.	WHEEL FACTOR	LANE FACTOR	Midspan Transformed Concrete Section: SLAB 28 DAY Strength (PSI)	SLAB Design DEPTH	SLAB Eff. WIDTH (n x b_e)	SECTION AREA (in^2)	SECTION CENTROID YC	MOMENT of INERTIA (in^4)	✻ SUPER-IMPOSED DEAD LOADS
1									
2									
3									

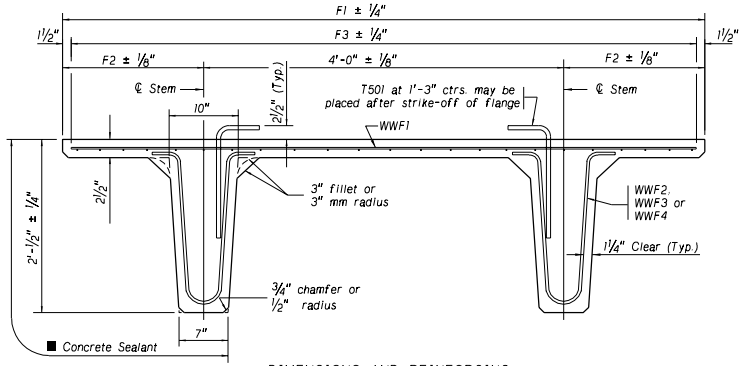
PROJECT NUMBER | SHEET NO.

C.N.

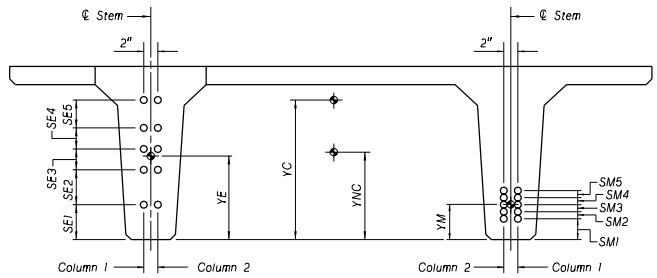
STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 — PROFESSIONAL STRUCTURAL ENGINEER — STATE OF NEBRASKA

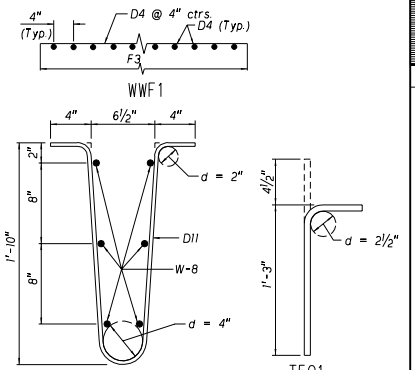
BRIDGE ENGINEER



DIMENSIONS AND REINFORCING

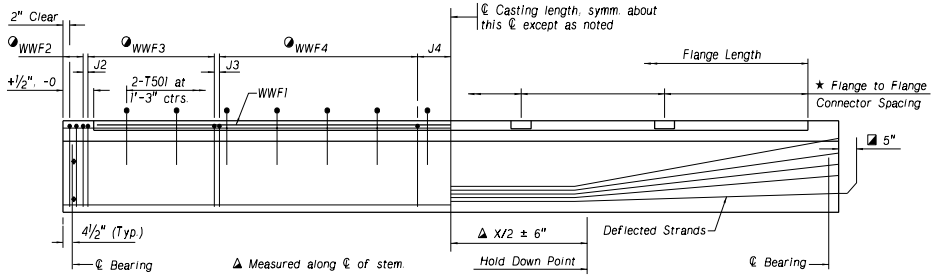


STRAND SPACING

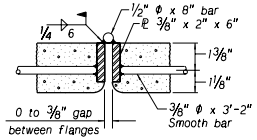


WWF2, WWF3, & WWF4

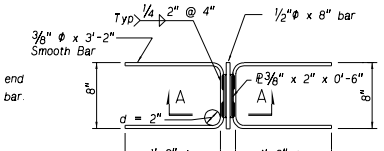
BENDING DIAGRAMS



ELEVATION OF PRESTRESSED DOUBLE TEE



SECTION A-A



PLAN VIEW

PRESTRESSED GIRDER NOTES:

Concrete in the beams shall be class "47B-P" or "47B-PHE", with ultimate cylinder strengths at stress transfer and at 28 days as shown in the data table. No bond stress shall be transferred to the concrete nor the end anchorage released until the concrete has attained the specified strength. The prestress shall be released in a manner that will minimize eccentricity. Tops of beams shall be rough finished by scarifying the surface transversely with a coarse wire brush. No laitance shall remain on the surface.

The fabricator shall be responsible for exercising extreme care in lifting, handling, storing and transportation of the prestressed girders to prevent cracking or damage. Girders shall be maintained in an upright position and be supported near the ends at all times. Proper support bearings shall be used to avoid twisting of the girders. Girders shall be lifted by devices designed by the fabricator.

Prestressing strands shall be uncoated, seven-wire, low-relaxation steel strand of nominal 0.6" diameter, and shall conform to the requirements of ASTM designation A416, grade 270. Strands shall be tensioned to an initial prestress force of 43.94 Kips per strand. Deflected strands may be stressed in the draped position, or straight strands may be partially stressed and then lifted or depressed. The method chosen shall be executed in a manner to ensure that both ends of all strands in the beam are uniformly tensioned. All methods and procedures employed in tensioning the strands shall be subject to the engineer's approval.

Reinforcing Steel shall conform to the requirements of ASTM designation A615/A615M, grade 60. Welded Wire Fabric (WWF) reinforcement shall conform to the requirements of ASTM A497.

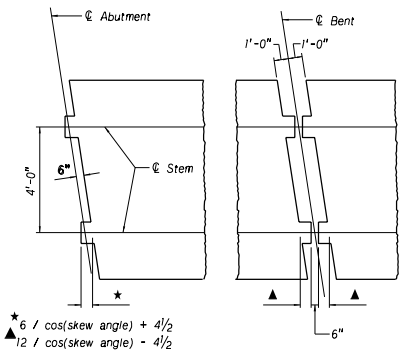
Structural steel for bars and bearing plates shall conform to the requirements of ASTM A709, grade 36 or grade 50W weathering steel. The grade 36 steel shall be galvanized according to the requirements of ASTM A123/A123M.

■ *CONCRETE SEALANT shall be applied to the outside of the exterior girders, as shown. Sealant shall be Sil-Act 40, manufactured by Act Corporation, Stifel, manufactured by Nox-Crete or approved equal.*

◪ *The bottom pair of strands in each stem shall be extended 1'-6" at both ends, and a strand bender shall be used to make the two 45° bends shown. Appropriate steps shall be taken to avoid damage to the strands.*

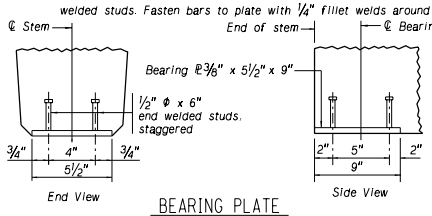
✻ *For rating purpose only, superimposed dead loads do not include future wearing surface.*

★ *Equal spaces - 8 ft maximum.*



FLANGE BLOCKOUTS

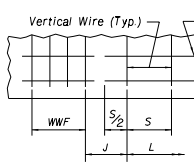
NOTE 1/2"Φ X 1'-3" or longer smooth bars may be substituted for the end welded studs. Fasten bars to plate with 1/4" fillet welds around the bar.



BEARING PLATE

WELDED WIRE FABRICS (WWF1 as shown in Bending Diagrams)

SPAN NO.	WWF2 S2	WWF2 L2	WWF2 J2	WWF3 S3	WWF3 L3	WWF3 J3	WWF4 S4	WWF4 L4	WWF4 J4



FABRIC PLACEMENT DETAIL

FLANGE TO FLANGE CONNECTOR

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

9.4.5

TTPRECTE.DGN

Sheet A

* Shown on this page

LEVEL 40 = IT300
LEVEL 41 = IT400
LEVEL 42 = IT500
LEVEL 43 = IT600

LEVEL 44 = IT700
LEVEL 45 = IT800
* LEVEL 46 = IT900

PROJECT NUMBER	SHEET NO.

IT-900 GIRDER DESIGN

SPAN NO.	GIRDER CASTING LENGTH (Feet)	CONCRETE STRENGTH (PSI) AT RELEASE	CONCRETE STRENGTH (PSI) AT 28 DAYS	NO. OF STRANDS PER GIRDER	STRANDS PER ROW AT MIDSPAN R1	STRANDS PER ROW AT MIDSPAN R2	NUMBER of DEBONDED STRANDS	STRAND CENTROID MIDSPAN YM

NON-COMPOSITE PROPERTIES

GIRDER MASS (lbs/Ft)	GIRDER AREA (in^2)	GIRDER CENTROID YNC	MOMENT of INERTIA (in^4)	MIDSPAN CAMBER AT RELEASE	MIDSPAN CAMBER AT 30 DAYS	DEFLECTION FOR SHIMS (Due to Slab) Span Tenth Points (Sym.) .1	.2	.3	.4	.5

COMPOSITE PROPERTIES

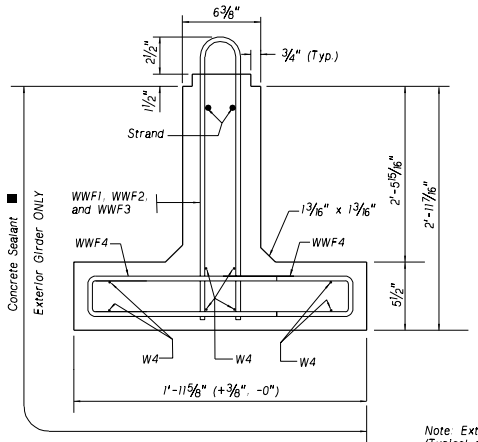
Midspan Transformed Concrete Section

WHEEL FACTOR	LANE FACTOR	SLAB 28 DAY Strength (PSI)	SLAB Design DEPTH (in)	SLAB Eff. WIDTH (n x b_e)	SECTION AREA (in^2)	SECTION CENTROID YC	MOMENT of INERTIA (in^4)	* SUPER-IMPOSED DEAD LOADS

DEBONDED STRAND

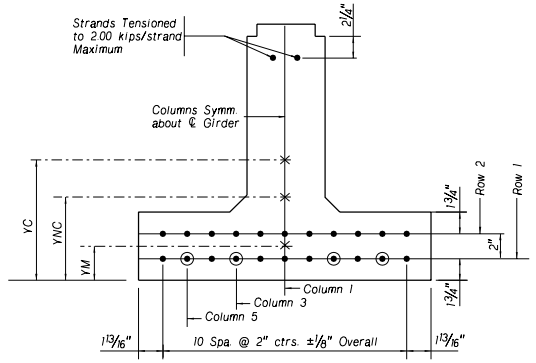
SPAN NUMBER	LOCATION ROW	LOCATION COLUMN	DEBOND LENGTH
	1		
	2		
	1		
	2		

Note: Debonding length is measured from end of girder (Typical).

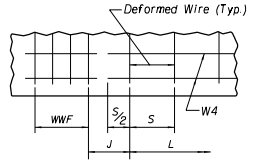


DIMENSIONS AND REINFORCING

Note: Extend circled strands (Typical at Both ends)



STRAND SPACINGS

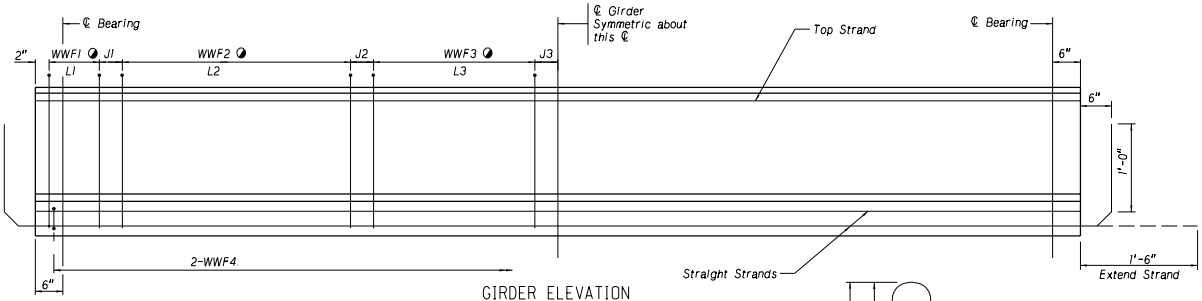


S = Deformed wire spacing
L = Length of WWF mats
J = Distance Between WWF mats

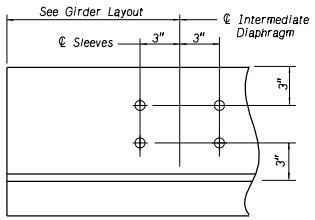
FABRIC PLACEMENT DETAIL

◕ WELDED WIRE FABRICS (WWF4 as shown in Bending Diagrams)

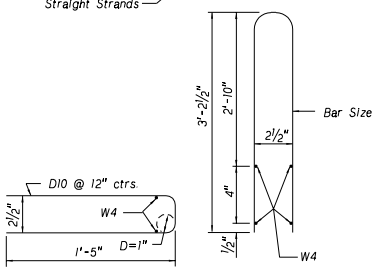
SPAN NO.	BAR SIZE	WWF1 S1	WWF1 L1	J1	BAR SIZE	WWF2 S2	WWF2 L2	J2	BAR SIZE	WWF3 S3	WWF3 L3	J3
	D22	2"	12"		D14	4"			D14	8"		
	D22	2"	12"		D14	4"			D14	8"		
	D22	2"	12"		D14	4"			D14	8"		
	D22	2"	12"		D14	4"			D14	8"		



GIRDER ELEVATION
Not to Scale



SLEEVE DETAIL
Not to Scale



WWF4

WWF1, WWF2, WWF3

BENDING DETAILS

PRESTRESSED GIRDER NOTES:

FABRICATOR shall be responsible for exercising extreme care in lifting, handling, storing and transportation of the prestressed girders to prevent cracking or damage. Girders shall be maintained in an upright position and supported near the ends at all times. Proper support bearings shall be used to avoid twisting of the girders. Girders shall be lifted by devices designed by the fabricator.

PRESTRESSING STRAND shall be uncoated, seven-wire, low-relaxation steel strand of 0.5" nominal diameter, and shall conform to the requirements of ASTM A416, Grade 270. Strands shall be tensioned to 30.98 kips before release, unless specified otherwise. All methods employed and procedures to be followed in tensioning the strands shall be subject to the Engineer's approval. The method chosen shall be executed in a manner to assure that both ends of all strands in the girder are uniformly tensioned. The prestressed strand shall be released in a manner that will minimize eccentricity.

CONCRETE in the girders shall be Class "47B-P" or "47B-PHE", with concrete strengths at stress transfer and at 28 days as shown in data table. No bond stress shall be transferred to the concrete nor the end anchorage released until the concrete has attained the specified strength. All exposed edges of girders, except at top and ends, shall be chamfered 3/4".

■ *CONCRETE SEALANT shall be applied to the outside of the exterior girders, as shown. Sealant shall be Sil-Act 40, manufactured by Act Corporation, Stifel, manufactured by Nox-Crete or approved equal.*

TOP OF THE STEM shall be rough finished by scarifying the surface transversely with a wire brush, and no laitance shall remain on the surface.

REINFORCING STEEL shall conform to the requirements of ASTM designation A615/A615M, Grade 60. Welded Wire Fabric (WWF) shall conform to the requirements of ASTM A497. As an alternate for WWF, an equivalent rebar area may be substituted for the design shear reinforcement.

TOLERANCES shall be in accordance with the Prestressed Concrete Institute manual.

* *For rating purpose only, superimposed dead loads do not include future wearing surface.*

C.N.
STRUCTURE NUMBER
BRIDGE ENGINEER

INVERTED T GIRDER DATA

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DESIGNED BY
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

SPECIAL PLAN NO.

INVTEECTE3.DGN

Feb. 12, 2004

Sheet 4

6.4.6

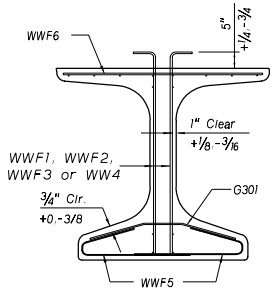
* Shown on this page

LEVEL 36 = NU 1100
* LEVEL 37 = NU 1350
LEVEL 38 = NU 1600
LEVEL 39 = NU 1800

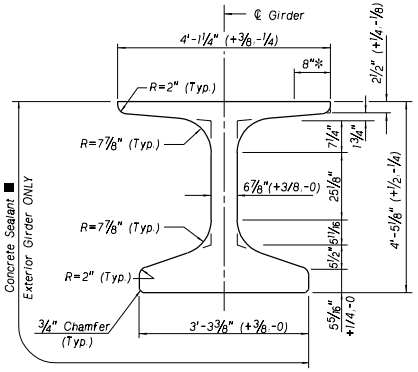
LEVEL 40 = NU 2000
* LEVEL 41 = Blockout - No skew
LEVEL 42 = Blockout RH skew < 30°
LEVEL 43 = Blockout RH skew > 30°

* LEVEL 47 = 2 P/T Ducts
LEVEL 48 = 3 P/T Ducts

NU1350P GIRDER DESIGN										NON-COMPOSITE PROPERTIES						COMPOSITE PROPERTIES									SUPER-IMPOSED DEAD LOADS
SPAN NO.	GIRDER CASTING LENGTH (FT,)	CONCRETE STRENGTH (PSI) AT RELEASE	CONCRETE STRENGTH (PSI) AT 28 DAYS	NO. OF STRANDS PER GIRDER	STRANDS PER ROW AT MIDSPAN R1	STRANDS PER ROW AT MIDSPAN R2	NUMBER of DEBONDED STRANDS	STRAND CENTROID MIDSPAN YM	BLOCK OUT DIMENSIONS Abutments	GIRDER Mass (Lbs/ft)	GIRDER AREA (in^2)	GIRDER CENTROID YNC	MOMENT of INERTIA (in^4)	MIDBEAM CAMBER AT RELEASE	MIDBEAM CAMBER AT 30 DAYS	WHEEL FACTOR	LANE FACTOR	SLAB 28 DAY Strength (PSI)	SLAB Design DEPTH (in)	Midspan Transformed Concrete Section SLAB Eff. WIDTH (in x b_e)	Midspan Transformed Concrete Section SECTION AREA (in^2)	Midspan Transformed Concrete Section SECTION CENTROID YC (in)	Midspan Transformed Concrete Section MOMENT of INERTIA (in^4)	Kips/ft

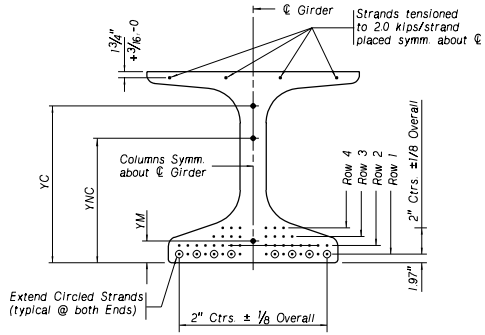


REINFORCING

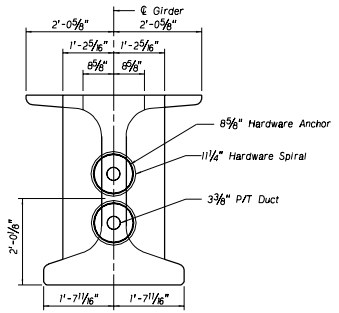


GIRDER DIMENSIONS

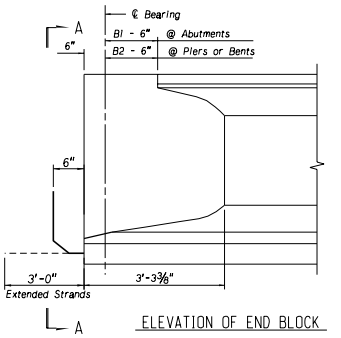
Note: All strands are straight.



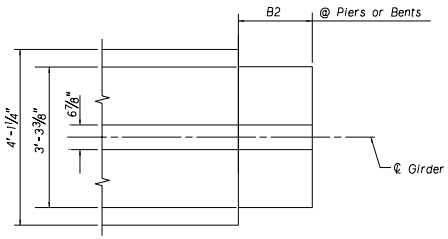
STRAND SPACINGS AND TOLERANCES

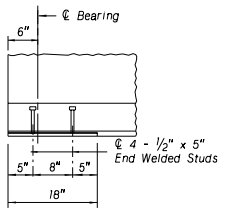


SECTION A-A

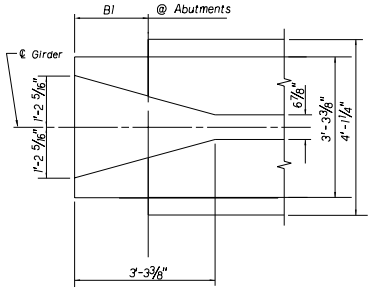


ELEVATION OF END BLOCK

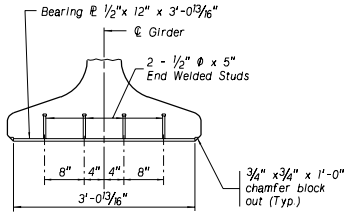




SIDE VIEW



TOP FLANGE BLOCK OUT DETAIL



END VIEW

BEARING PLATE

PRESTRESSED GIRDER NOTES:

FABRICATOR shall be responsible for exercising extreme care in lifting, handling, storing and transportation of the prestressed girders to prevent cracking or damage. Girders shall be maintained in an upright position and supported near the ends at all times. Proper support bearings shall be used to avoid twisting of the girders. Girders shall be lifted by devices designed by the fabricator.

PRESTRESSING STRAND shall be uncoated, seven-wire, low-relaxation steel strand of 0.6" nominal diameter, and shall conform to the requirements of ASTM A416/A416M, Grade 270. Strands shall be tensioned to 43.94 kips before release, unless specified otherwise. All methods and procedures employed in tensioning the strands shall be subject to the approval The method chosen shall be executed in a manner to ensure that both ends of all strands in the girder are uniformly tensioned. The prestressed strand shall be released in a manner that will minimize eccentricity.

CONCRETE in the girders shall be Class "47B-P" or "47B-PHE", with concrete strengths at stress transfer and at 28 days as shown in data table. No bond stress shall be transferred to the concrete nor the end anchorage released until the concrete has attained the specified strength. All exposed edges of girders, except at top and ends, shall be chamfered 3/4".

■ CONCRETE SEALANT shall be applied to the outside of the exterior girders, as shown. Sealant shall be SII-Act 40, manufactured by Act Corporation, Stifel, manufactured by Nox-Crete or approved equal.

* GIRDER TOP FLANGE shall be steel troweled to a smooth finish for 8" at the edges, as shown. Bond breaker shall be applied to this region only. The center portion shall be rough finished by scarifying the surface transversely with a wire brush, and no laitance shall remain on the surface.

REINFORCING STEEL shall conform to the requirements of ASTM A615/A615M, Grade 60 unless specified otherwise on the plans. Welded wire fabric (WWF) shall conform to the requirements of ASTM A497.

BEARING PLATES shall conform to the requirements of ASTM A709/A709M, Grade 36 or Grade 50W weathering steel. The Grade 36 steel shall be galvanized according to the requirements of ASTM A123/ A123M.

Tolerances shall be in accordance with the Prestressed Concrete Institute manual.

▲ Superimposed dead loads do not include future wearing surface.

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 — PROFESSIONAL STRUCTURAL ENGINEER — STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

Nebraska

SPECIAL PLAN NO.

647

NUPOSTCTEI.DGN

Feb. 12, 2004

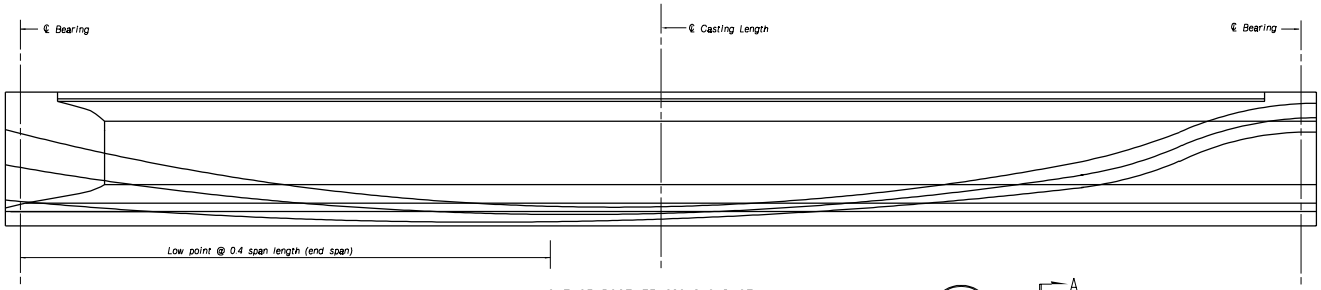
Sheet A

* Shown on this page

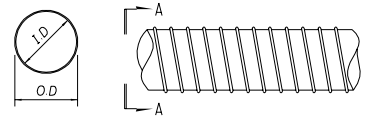
LEVEL 44 = Simple span
* LEVEL 45 = Multi spans
LEVEL 46 = 2 tendons - simple span
LEVEL 47 = 2 P/T Ducts

* LEVEL 48 = 3 P/T Ducts
LEVEL 49 = 3 tendons - simple span
LEVEL 50 = 2 tendons - Multi spans
* LEVEL 51 = 3 tendons - Multi spans

LAYOUT DISTANCES FOR POST-TENSIONING DUCTS (SPAN NO. 1)			LAYOUT DISTANCES FOR POST-TENSIONING DUCTS (SPAN NO. 2)			LAYOUT DISTANCES FOR POST-TENSIONING DUCTS (SPAN NO. 3)		
POINT DESCRIPTION	DISTANCE FROM ℄ ABUTMENT NO. 1 (ft)	ECCENTRICITY (in) FROM BOTTOM OF GIRDER TO ℄ GRAVITY OF DUCTS	POINT DESCRIPTION	DISTANCE FROM ℄ ABUTMENT NO. 1 (ft)	ECCENTRICITY (in) FROM BOTTOM OF GIRDER TO ℄ GRAVITY OF DUCTS	POINT DESCRIPTION	DISTANCE FROM ℄ ABUTMENT NO. 1 (ft)	ECCENTRICITY (in) FROM BOTTOM OF GIRDER TO ℄ GRAVITY OF DUCTS

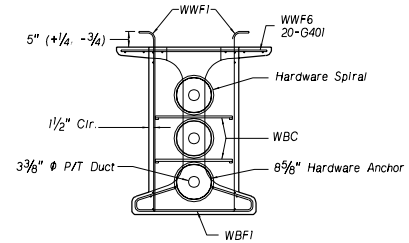


LAYOUT OF POST-TENSIONING DUCT

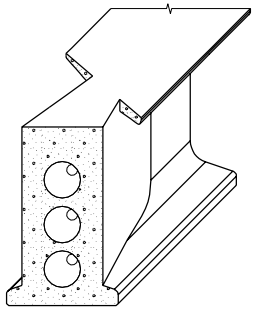


SECTION A-A PLAN VIEW

DUCT DETAIL

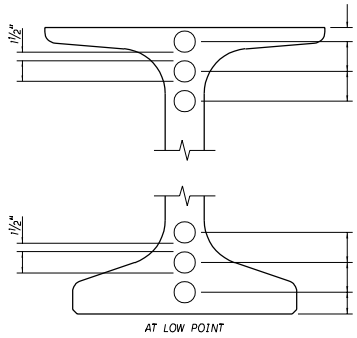


SECTION OF END BLOCK SHOWING REINFORCING



GENERAL ELEVATION OF GIRDER AT ABUTMENT END

Note: As an alternate, ducts may be placed without the 1½" spaces at the high point along the tendon profile.



POST-TENSIONING TENDON LAYOUT

POST-TENSIONING NOTES:

DRAINAGE OF BLOCKOUTS:
All post-tensioning anchorage blockouts in the girder shall be provided with suitable drain pipes to prevent standing water. Drain pipes shall be maintained free of obstructions at all times prior to filling the blockouts with grout after all post-tensioning is completed.

DUCTS: Post-tensioning ducts shall meet the following requirements:
1. Post-tensioning ducts shall be Rigid Galvanized Metal.
2. The ducts shall be tied to reinforcing bars at a maximum interval of 2'-0" to prevent displacement of the ducts during concrete casting.
3. Ducts shall have grouting vents at each interior support and at each low point along the tendon profile.
4. After installation, the ends of the ducts shall be sealed at all times to prevent entry of water and debris.
5. The duct placement tolerance shall be ±1/4" in the horizontal direction and ±1/2" in the vertical direction. However, the Engineer may relax the vertical tolerance if necessary to achieve a smooth duct profile.
6. A 3'-0" long (±) transition shall be fabricated to connect each post-tensioning anchorage to the adjacent duct.The contractor shall submit shop drawings showing complete details of these transitions to the engineer for approval.
7. The Contractor shall not set the girder side forms in place until the Engineer has visually inspected and approved the duct profile and reinforcing cage.
8. Before the girders are transported to the job site, the Contractor shall demonstrate that the ducts are not blocked by means approved by the engineer.
9. Any duct splice shall be designed to fit between the beam stirrups at a 6" spacing and shall not infringe on the clear cover. Stirrup spacing may be adjusted up to 2" provided the total number of stirrups within 3'-0" on either side of the splice is the same as required by the plans.

POST-TENSIONING SEQUENCING:
Post-tensioning shall be accomplished by alternating symmetrical pattern across the roadway, beginning at center girder(s). The middle Tendons shall be post-tensioned in all girders across the width of the roadway. This procedure shall be repeated for the bottom tendons and again for the top tendons. All tendons shall be stressed from both ends, one end at a time.

SHOP DRAWINGS:
The Contractor shall submit shop drawings showing complete details of the post-tensioning system to the Engineer for approval. The Contractor shall submit tendon stressing details for approval by the Engineer. These details shall indicate jacking forces, the sequence of stressing, calculated extensions at each jack, friction coefficient and anchor set loss.

JACKING FORCE:
The jacking force required before anchor set is 41 Kips per strand for 0.6" ϕ strand.

POST-TENSIONING PERSONNEL:
The full-time person in charge of the post-tensioning operation shall have a minimum of three years of full-time experience in post-tensioning. Documentation of this experience shall be submitted to the Engineer for approval.

PROCEDURES TO AVOID BLOCKED DUCTS:
The contractor shall preform the following procedures to avoid blocking post-tensioning ducts.
1. Before transporting the girder to job site. See duct note No. 8.
2. For wet joint girder splice. During or immediately after every wet joint girder splice is cast (if any), the Contractor shall demonstrate to the satisfaction of the engineer that the ducts are not blocked by methods shown on the shop plans and approved by the engineer. The contractor shall complete this demonstration before the wet joint girder splice concrete has taken its initial set.

** CONSTRUCTION SEQUENCE

* * Construction sequence shall be determined by the design engineer

PROJECT NUMBER | SHEET NO.

C.N.
STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

POST-TENSIONING DETAILS

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DESIGNED BY
DETAILED BY
CHECKED BY
DATE
COUNTY
HWY. NO.
REF. POST.
STA.

Nebraska

SPECIAL PLAN NO.

9.4.8

NUPOSTCTE.DGN

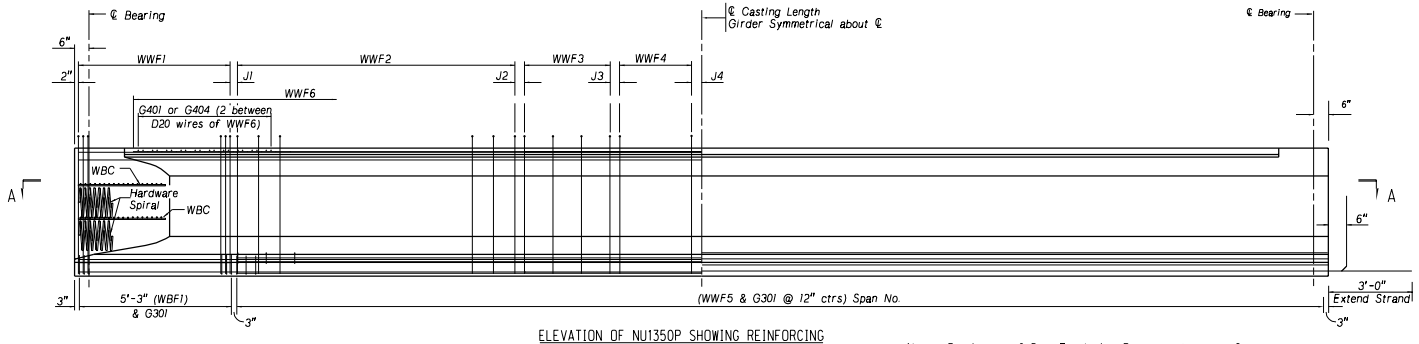
Sheet B

* Shown on this page

LEVEL 36 = NU 1100
* LEVEL 37 = NU 1350
LEVEL 38 = NU 1600
LEVEL 39 = NU 1800

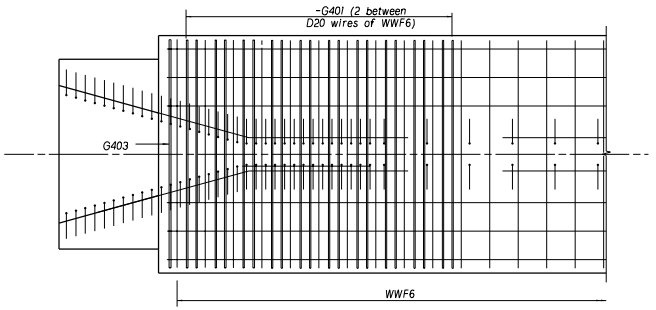
LEVEL 40 = NU 2000
* LEVEL 41 = Blockout - No skew
LEVEL 42 = Blockout RH skew < 30°
LEVEL 43 = Blockout RH skew > 30°

LEVEL 44 = Simple span
* LEVEL 45 = Multispan
* LEVEL 47 = 2 P/T Ducts
LEVEL 48 = 3 P/T Ducts

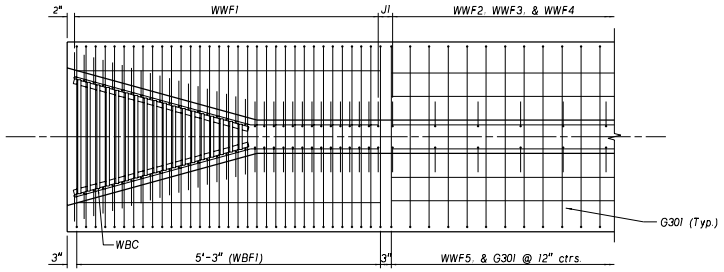


ELEVATION OF NU1350P SHOWING REINFORCING

Note : For Layout of Post Tensioning Duct see sheet of

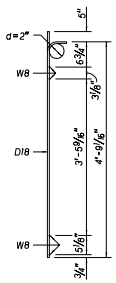


PART-PLAN OF GIRDER TOP FLANGE REINFORCING

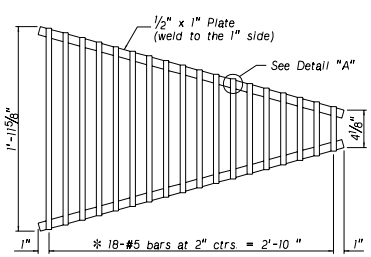


SECTION A-A PART-PLAN OF END BLOCK REINFORCING

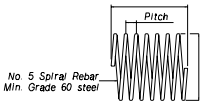
WELDED WIRE FABRIC (WWF5 & WWF6 as shown in Bending Diagrams)															
SPAN NO.	WWF1				WWF2				WWF3				WWF4			
	BAR SIZE	S1	L1	J1	BAR SIZE	S2	L2	J2	BAR SIZE	S3	L3	J3	BAR SIZE	S4	L4	J4
1	D18	50			D18	100			D18	200			D18	300		-
2	D18	50			D18	100			D18	200			D18	300		-
3																



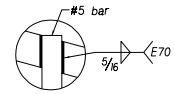
WWF1, WWF2, WWF3, & WWF4



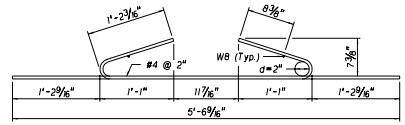
WBC



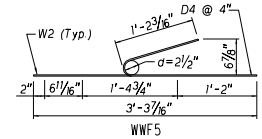
HARDWARE SPIRAL



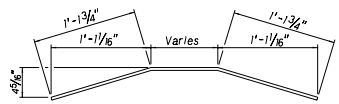
DETAIL "A"



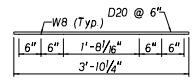
WBF1



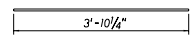
WWF5



G301

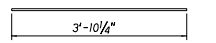


WWF6

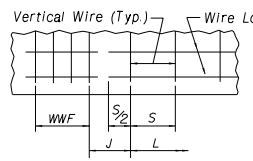


G401

S = Vertical wire spacing
L = Length of WWF mats
J = Distance Between WWF mats



G403



FABRIC PLACEMENT DETAIL

BENDING DIAGRAMS FOR NU1350P

PROJECT NUMBER | SHEET NO.

C.N.
STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

NU1350P GIRDER REINFORCEMENT DETAILS

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.
DESIGNED BY

Nebraska

SPECIAL PLAN NO.

6.4.9

NUPOSTCTE.DGN

Sheet C

* Shown on this page

*LEVEL 50 = Bridge Deck on Girders
LEVEL 51 = Concrete Slab Bridge Deck
LEVEL 52 = Bridge Deck on Double Tee
*LEVEL 53 = Lighting
LEVEL 54 = w/Block Out
*LEVEL 55 = 2'-8" Concrete Barrier
LEVEL 56 = 3'-6" Concrete Barrier
*LEVEL 57 = w/o block out

CONBARLTE2.DGN

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 PROFESSIONAL STRUCTURAL ENGINEER STATE OF NEBRASKA

BRIDGE ENGINEER

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DESIGNED BY
DETAILED BY
CHECKED BY
DATE

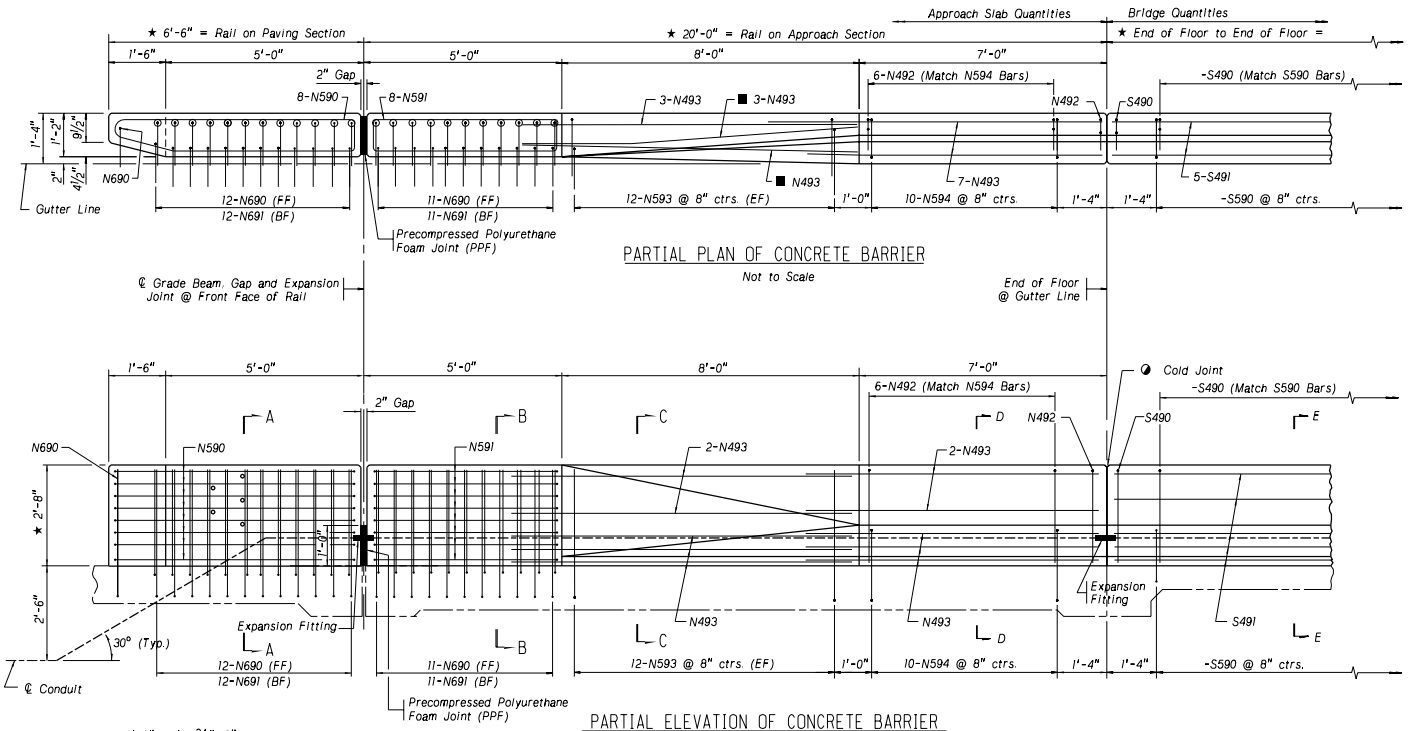
COUNTY
HWY. NO.
REF. POST.
STA.

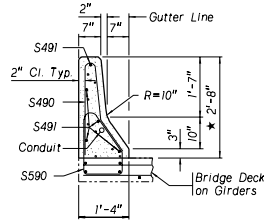
STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

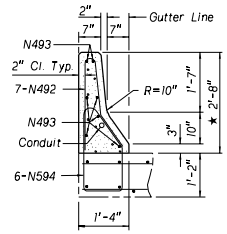
SPECIAL PLAN NO.

6.5.1

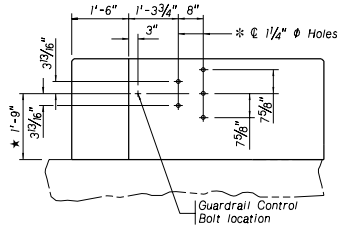




SECTION E-E

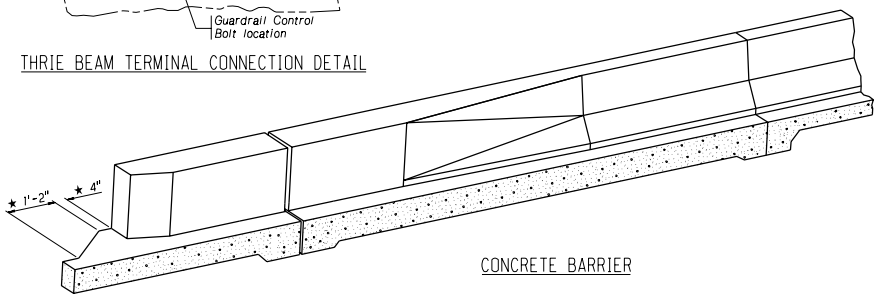


SECTION D-D

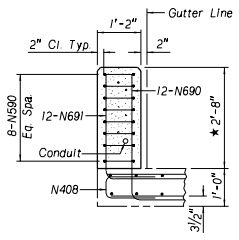


THRIE BEAM TERMINAL CONNECTION DETAIL

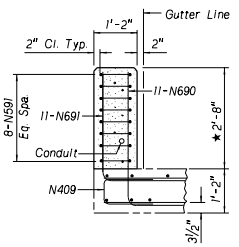
*As an alternate method, the contractor shall furnish and cast into the concrete an approved welded assembly consisting of threaded inserts, held accurately to the template of the holes shown. Inserts are to be complete with galvanized plate washers and galvanized ⅞" x 2" cap screws. The insert assembly shall be a standard product of a reputable manufacturer of such items and be capable of resisting a shear load of 80,000 lbs.



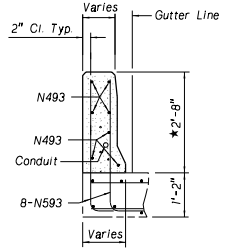
CONCRETE BARRIER



SECTION A-A



SECTION B-B



SECTION C-C

NOTES

⊙ Circled bars indicate placement in the top layer of slab reinforcement.
■ Field bend as needed.
★ Measured at gutter line. Concrete Barrier will be built plumb.
(EF) = Each Face
(FF) = Front Face
(BF) = Back Face

▲ As an alternate design, epoxy coated welded wire fabric conforming to the requirements of ASTM A497 may be substituted for the S490 and S491 bars. The fabric shall be bent to the shape and length of the S490 bar and provide a minimum of 0.16 in²/ft. of reinforcement, each direction.

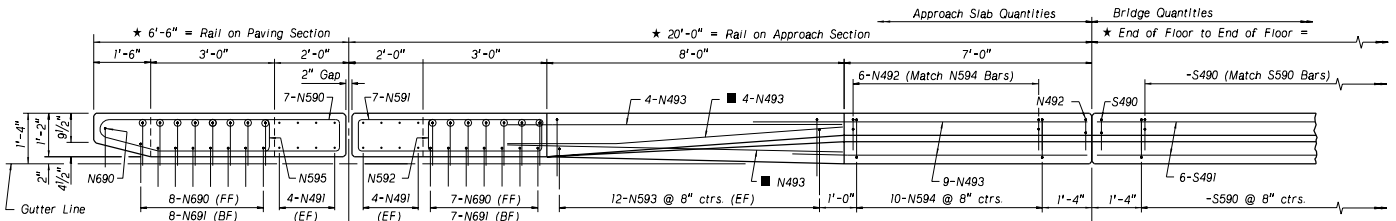
◕ When pouring concrete rails, a mandatory chamfered cold joint must be formed at the end of floor.

Feb. 12, 2004

Sheet 4

LEVEL 50 = Bridge Deck on Girders
✻LEVEL 51 = Concrete Slab Bridge Deck
LEVEL 52 = Bridge Deck on Double Tee
LEVEL 53 = Lighting
✻ LEVEL 54 = w/Block Out
LEVEL 55 = 2'-8" Concrete Barrier
✻ LEVEL 56 = 3'-6" Concrete Barrier
LEVEL 57 = w/o block out

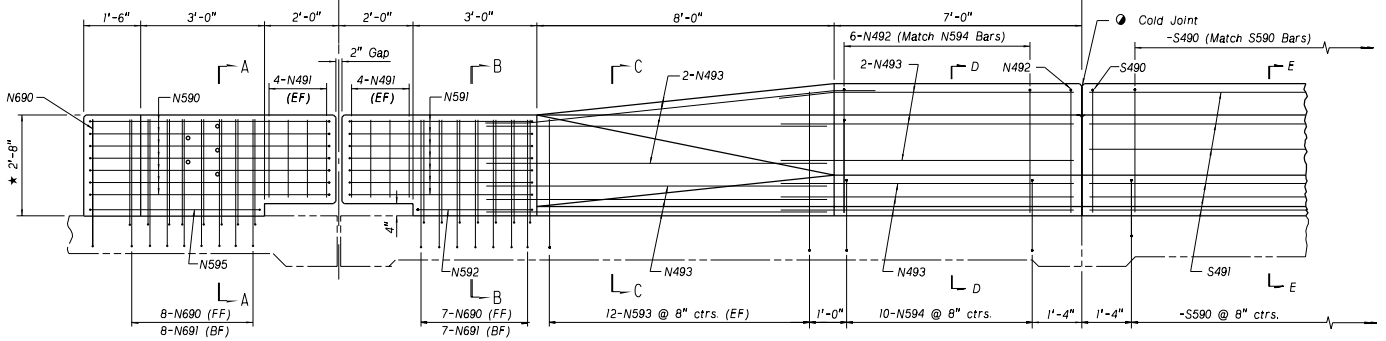
✻ Shown on this page



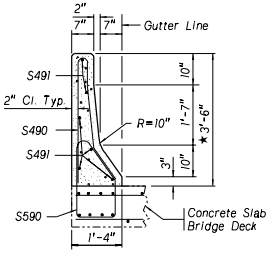
PARTIAL PLAN OF CONCRETE BARRIER
Not to Scale

℄ Grade Beam, Gap and Expansion Joint @ Front Face of Rail

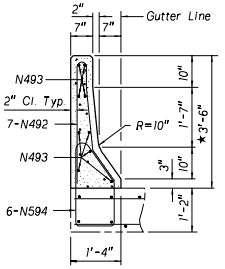
End of Floor @ Gutter Line



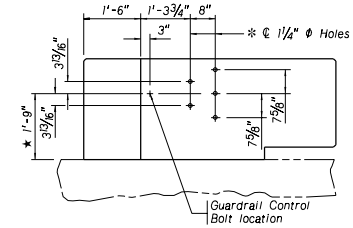
PARTIAL ELEVATION OF CONCRETE BARRIER



SECTION E-E

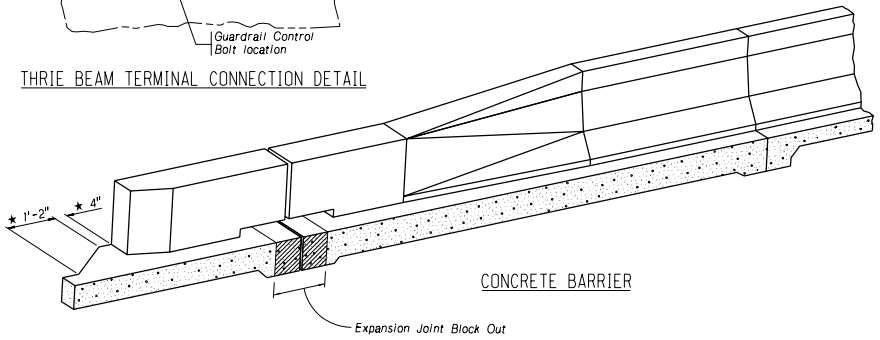


SECTION D-D

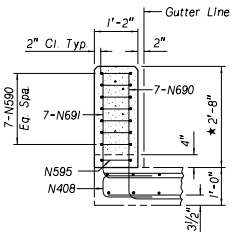


THRIE BEAM TERMINAL CONNECTION DETAIL

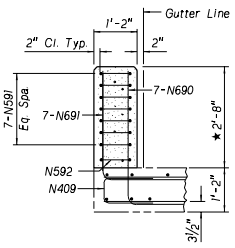
✻As an alternate method, the contractor shall furnish and cast into the concrete an approved welded assembly consisting of threaded inserts, held accurately to the template of the holes shown. Inserts are to be complete with galvanized plate washers and galvanized ⅞" x 2" cap screws. The insert assembly shall be a standard product of a reputable manufacturer of such items and be capable of resisting a shear load of 80,000 lbs.



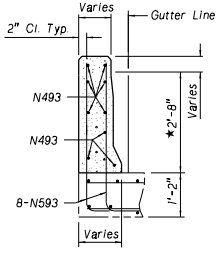
CONCRETE BARRIER



SECTION A-A



SECTION B-B



SECTION C-C

NOTES

⊙ Circled bars indicate placement in the top layer of slab reinforcement.
■ Field bend as needed.
★ Measured at gutter line. Concrete Barrier will be built plumb.
(EF) = Each Face
(FF) = Front Face
(BF) = Back Face

▲ As an alternate design, epoxy coated welded wire fabric conforming to the requirements of ASTM A497 may be substituted for the S490 and S491 bars. The fabric shall be bent to the shape and length of the S490 bar and provide a minimum of 0.16 in²/ft. of reinforcement, each direction.

◕ When pouring concrete rails, a mandatory chamfered cold joint must be formed at the end of floor.

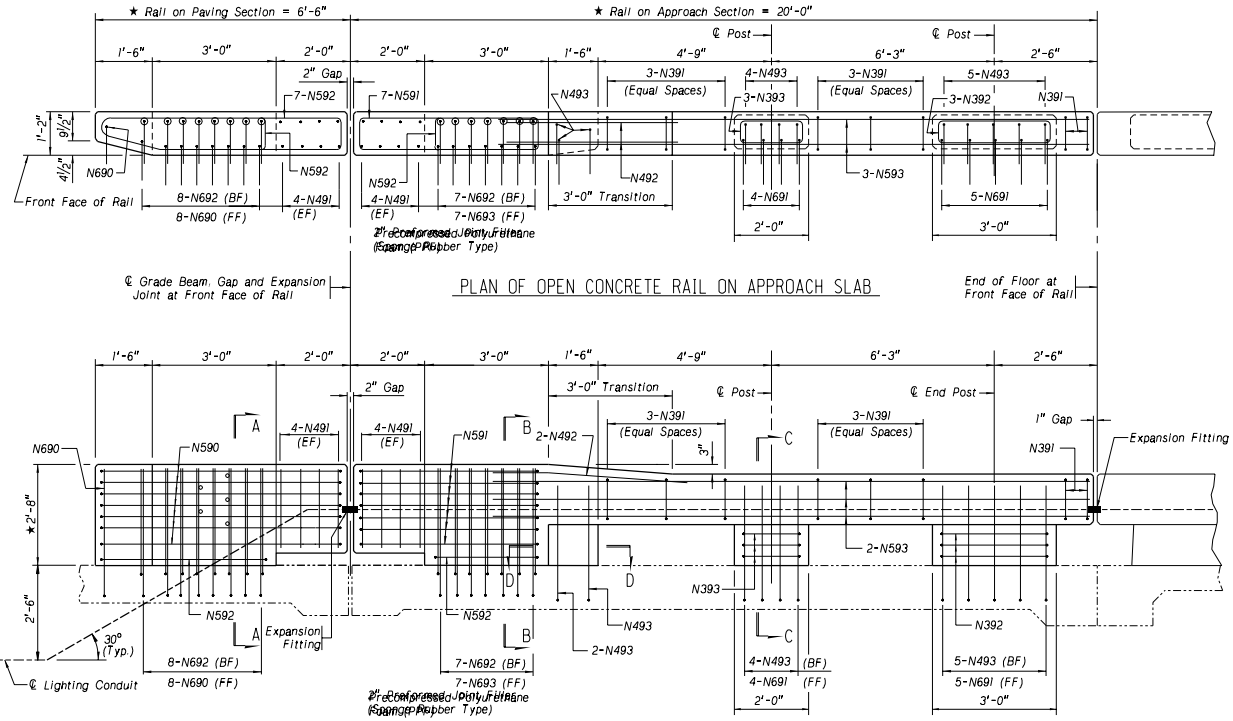
PROJECT NUMBER | SHEET NO.
C.N.
STRUCTURE NUMBER
BRIDGE ENGINEER
LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DESIGNED BY
DETAILED BY
CHECKED BY
DATE
COUNTY
HWY. NO.
REF. POST.
STA.
STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION
Nebraska
SPECIAL PLAN NO.

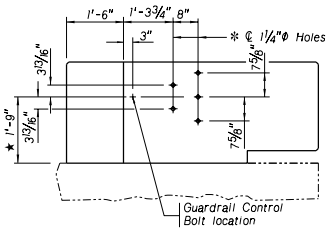
CONBARCTEI.DGN
Feb, 10, 2004
Sheet A
6.5.2

* Shown on this page

* LEVEL 50 = Brige Deck on Girders
LEVEL 51 = Concrete Slab Bridge Deck
LEVEL 52 = Bridge Deck on Double Tee
* LEVEL 53 = Lighting Details

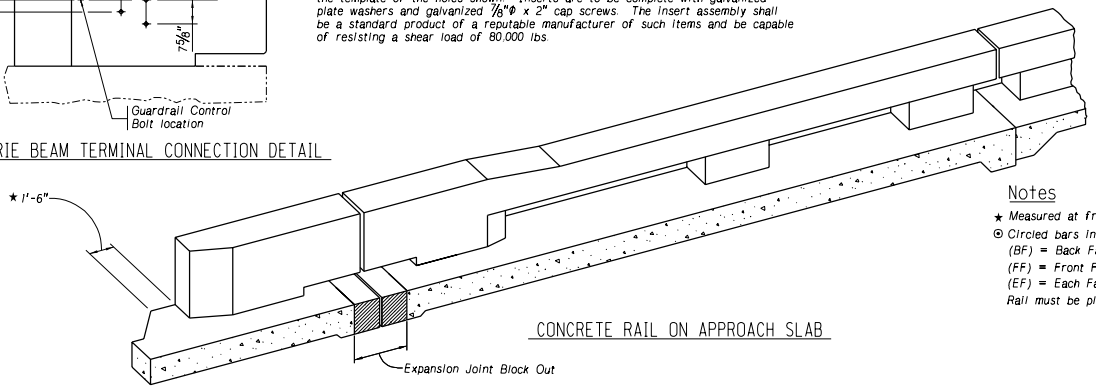
* LEVEL 54 = Block out for Strip Seal Joints
LEVEL 55 = No block out
* LEVEL 57 = 2" Preformed Joint Filler
LEVEL 58 = PPF





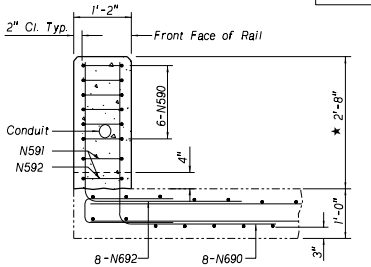
THRIE BEAM TERMINAL CONNECTION DETAIL

* As an alternate method, the contractor shall furnish and cast into the concrete an approved welded assembly consisting of threaded inserts, held accurately to the template of the holes shown. Inserts are to be complete with galvanized plate washers and galvanized ⅞"Φ x 2" cap screws. The insert assembly shall be a standard product of a reputable manufacturer of such items and be capable of resisting a shear load of 80,000 lbs.

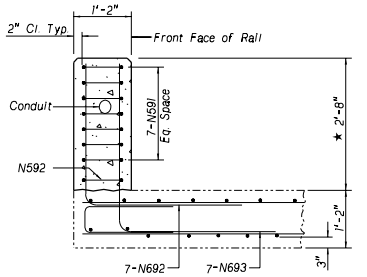


CONCRETE RAIL ON APPROACH SLAB

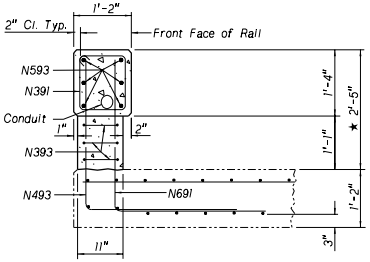
Notes
★ Measured at front face of rail.
⊙ Circled bars indicate placement in the top layer.
(BF) = Back Face
(FF) = Front Face
(EF) = Each Face
Rail must be plumb.



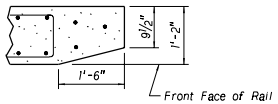
SECTION A-A



SECTION B-B



SECTION C-C



SECTION D-D

PROJECT NUMBER	SHEET NO.

C.N.
STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 PROFESSIONAL STRUCTURAL ENGINEER STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DESIGNED BY
DETAILED BY
CHECKED BY
DATE
COUNTY
HWY. NO.
REF. POST.
STA.

Nebraska

SPECIAL PLAN NO.

6.5.3

CONRALCTEI.DGN

FEB. 12, 2004

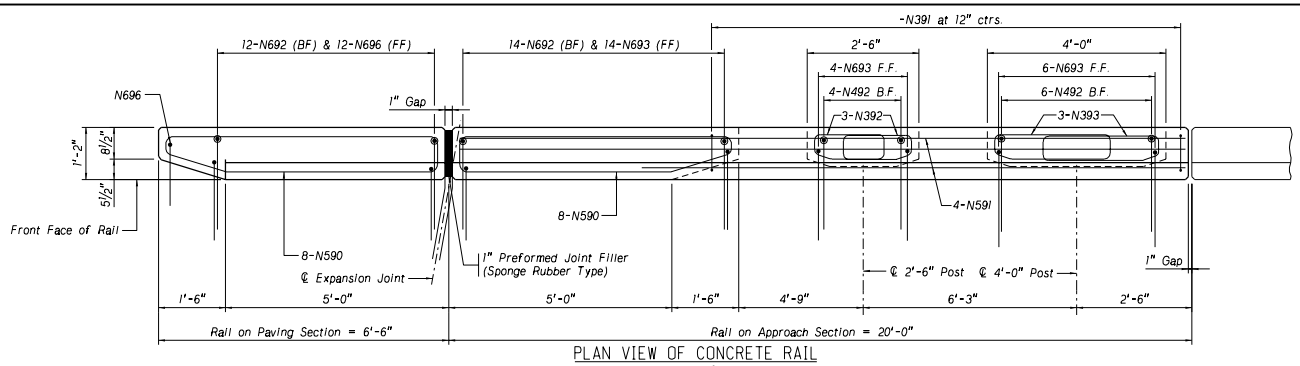
Sheet A

* Shown on this page

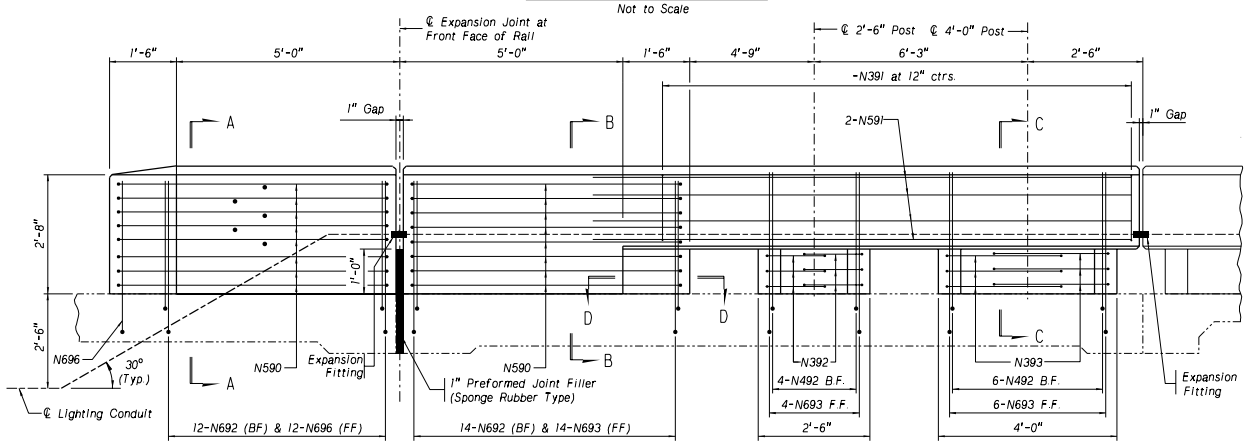
*LEVEL 50 = Bridge Deck on Girders
LEVEL 51 = Concrete Slab Bridge Deck
LEVEL 52 = Bridge Deck on Double Tee
*LEVEL 53 = Lighting

*LEVEL 54 = 1" PJF
LEVEL 55 = 2" PPF
LEVEL 56 = LOOP BAR

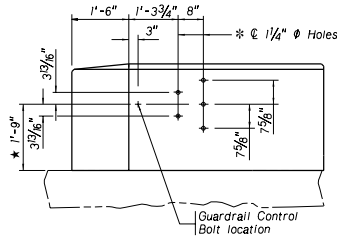
n:\brdge\ref\openrail34a.dgn



PLAN VIEW OF CONCRETE RAIL
Not to Scale



ELEVATION OF CONCRETE RAIL
Not to Scale



THRIE BEAM TERMINAL CONNECTION DETAIL

*As an alternate method, the contractor shall furnish and cast into the concrete an approved welded assembly consisting of threaded inserts, held accurately to the template of the holes shown. Inserts are to be complete with galvanized plate washers and galvanized ⅞" x 2" cap screws. The insert assembly shall be a standard product of a reputable manufacturer of such items and be capable of resisting a shear load of 80,000 lbs.

NOTES

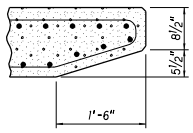
⊙ Circled bars indicate placement in the top layer of slab reinforcement.

Concrete Rail will be built plumb.

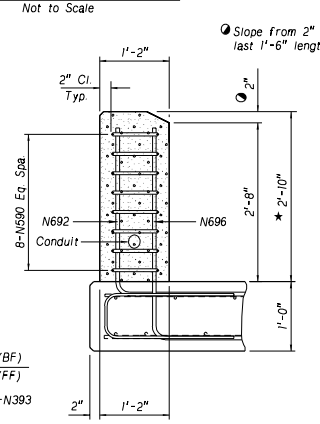
★ Measured at front face of rail.

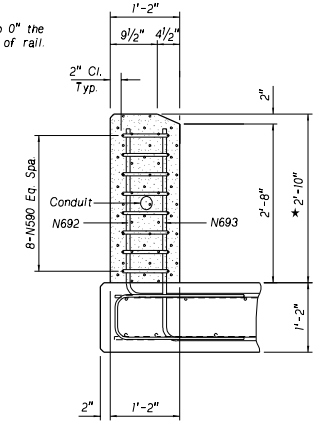
For Bill of Bars see sheet of .

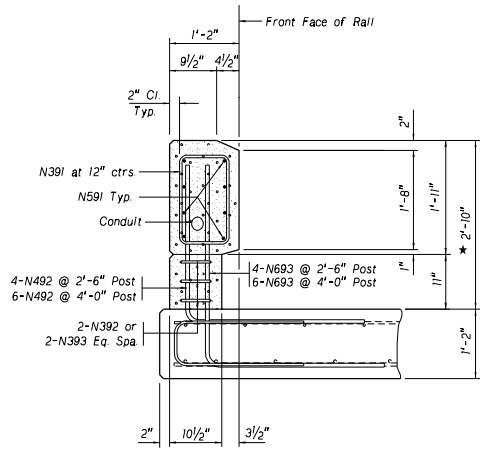
(EF) = Each Face
(FF) = Front Face
(BF) = Back Face



SECTION D-D
Not to Scale







PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

BRIDGE ENGINEER

NU OPEN RAIL ON APPROACH SLABS (TL4)

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DESIGNED BY | DETAILED BY | CHECKED BY | DATE

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.5.3.1.1

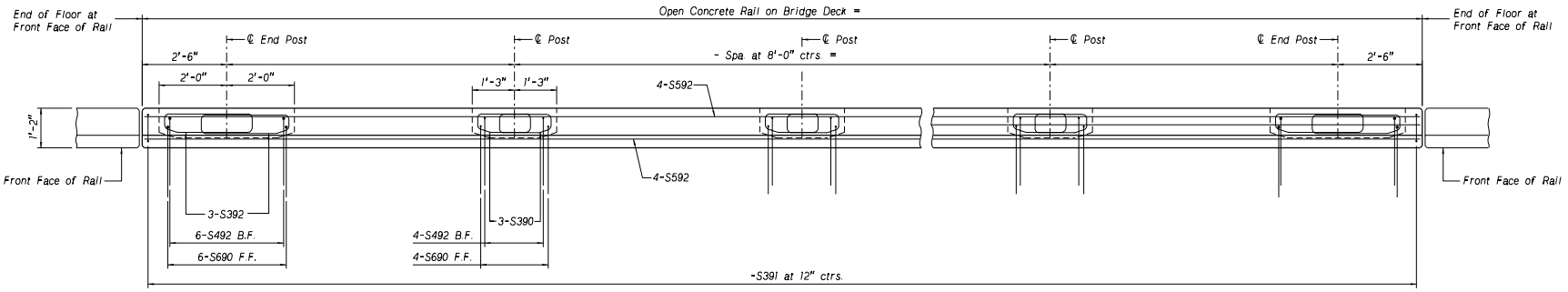
Sept. 12, 2004

Sheet A

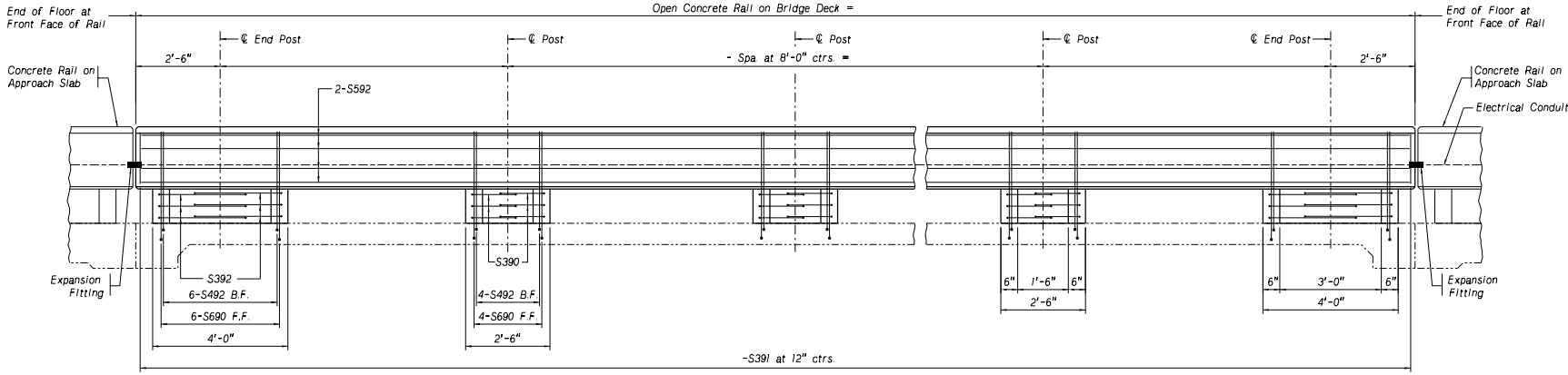
* Shown on this page

*LEVEL 50 = Bridge Deck on Girders
LEVEL 51 = Concrete Slab Bridge Deck
LEVEL 52 = Bridge Deck on Double Tee
*LEVEL 53 = Lighting

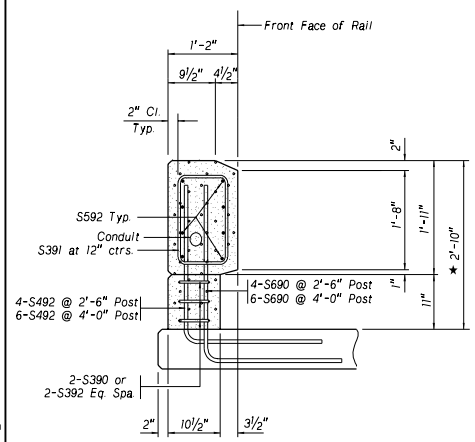
* LEVEL 54 = 1" PJF
LEVEL 55 = 2" PPF
LEVEL 56 = LOOP BAR



PLAN OF OPEN CONCRETE RAIL ON BRIDGE



ELEVATION OF OPEN CONCRETE RAIL ON BRIDGE



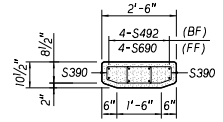
TYPICAL SECTION OF RAIL

NOTES:

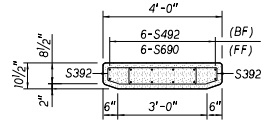
Posts must be plumb.

★ Measured at front face of rail.

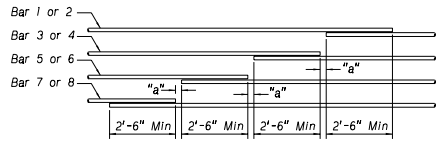
For Bill of Bars see sheet of



PLAN OF 2'-6" POST

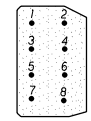


PLAN OF 4'-0" POST



"a" ≥ Zero

LAP DETAIL



RAIL SECTION
See Lap Detail

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

LYMAN D. FREEMON E-2005 PROFESSIONAL STRUCTURAL ENGINEER STATE OF NEBRASKA

BRIDGE ENGINEER

NU OPEN CONCRETE RAIL ON BRIDGE (TL4)

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
CHECKED BY
DATE
DETAILED BY
DESIGNED BY
COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

6.5.3.1.2

NURAIL1.DGN

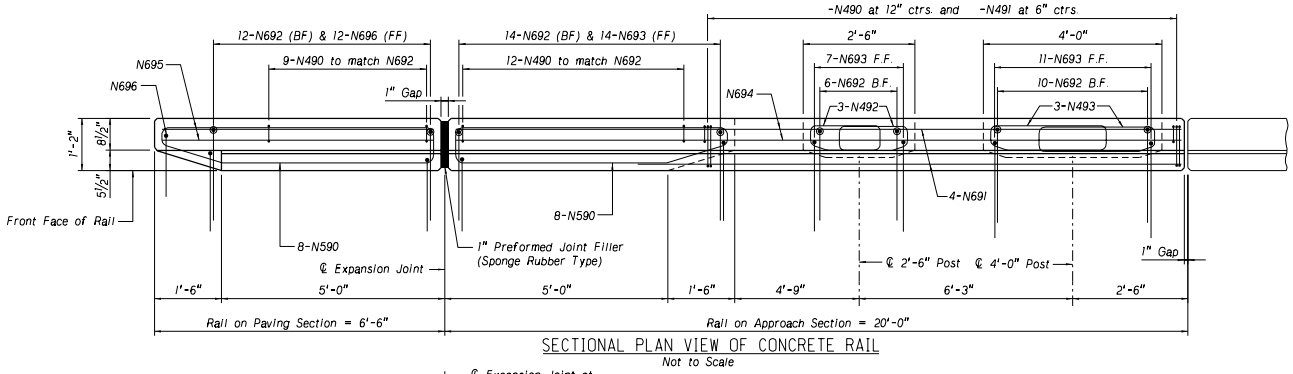
Sept. 12, 2004

Sheet B

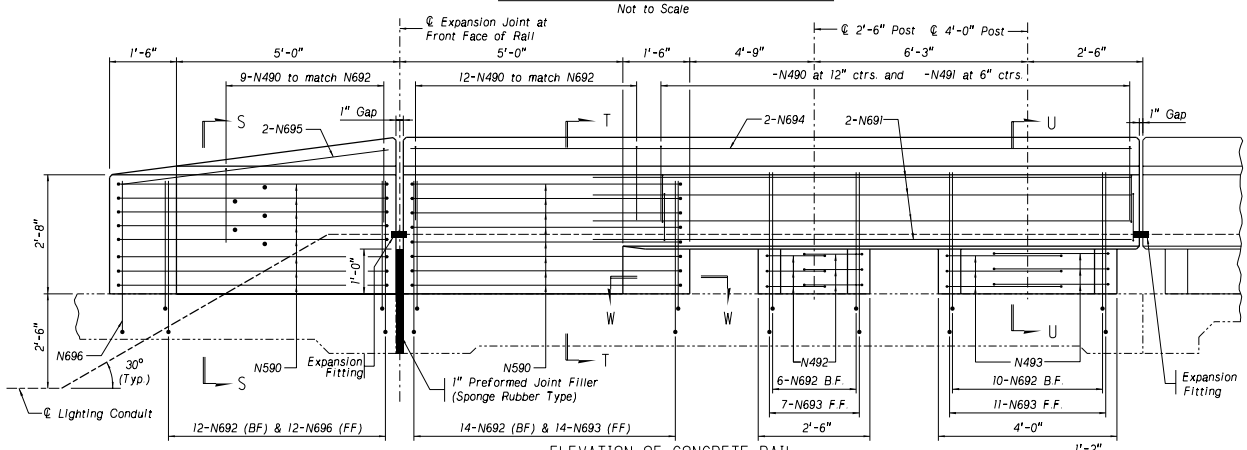
* Shown on this page

*LEVEL 50 = Bridge Deck on Girders
LEVEL 51 = Concrete Slab Bridge Deck
LEVEL 52 = Bridge Deck on Double Tee
*LEVEL 53 = Lighting

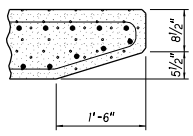
* LEVEL 54 = 1" PJF
LEVEL 55 = 2" PPF
LEVEL 56 = LOOP BAR



SECTIONAL PLAN VIEW OF CONCRETE RAIL
Not to Scale



ELEVATION OF CONCRETE RAIL
Not to Scale

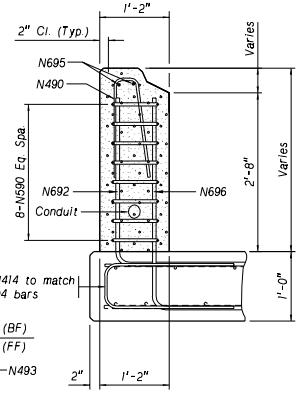


SECTION W-W
Not to Scale

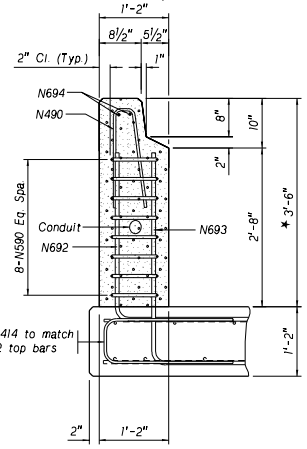
CONCRETE BARRIER

PLAN OF 2'-6" POST

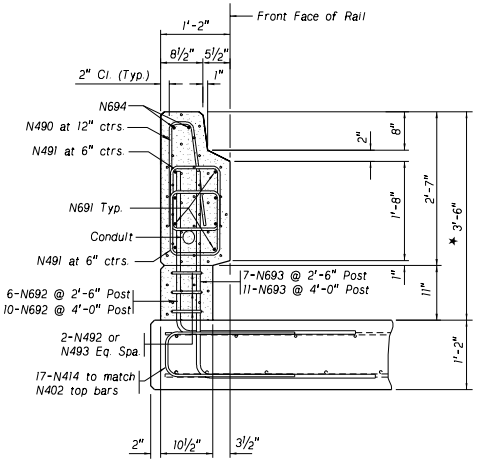
PLAN OF 4'-0" POST



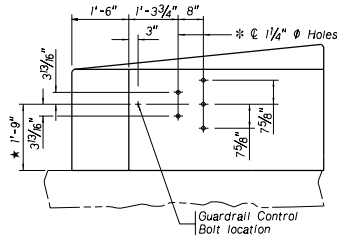
SECTION S-S
Not to Scale



SECTION T-T
Not to Scale



SECTION U-U
Not to Scale



THRIE BEAM TERMINAL CONNECTION DETAIL

*As an alternate method, the contractor shall furnish and cast into the concrete an approved welded assembly consisting of threaded inserts, held accurately to the template of the holes shown. Inserts are to be complete with galvanized plate washers and galvanized ⅞" x 2" cap screws. The insert assembly shall be a standard product of a reputable manufacturer of such items and be capable of resisting a shear load of 80,000 lbs.

NOTES

⊙ Circled bars indicate placement in the top layer of slab reinforcement.

Concrete Rail will be built plumb.

★ Measured at front face of rail.

For Bill of Bars see sheet of .

(EF) = Each Face
(FF) = Front Face
(BF) = Back Face

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER — LYMAN D. FREEMON E-2005 — STATE OF NEBRASKA

BRIDGE ENGINEER

OPEN CONCRETE RAIL ON APPROACH SLABS

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DESIGNED BY
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

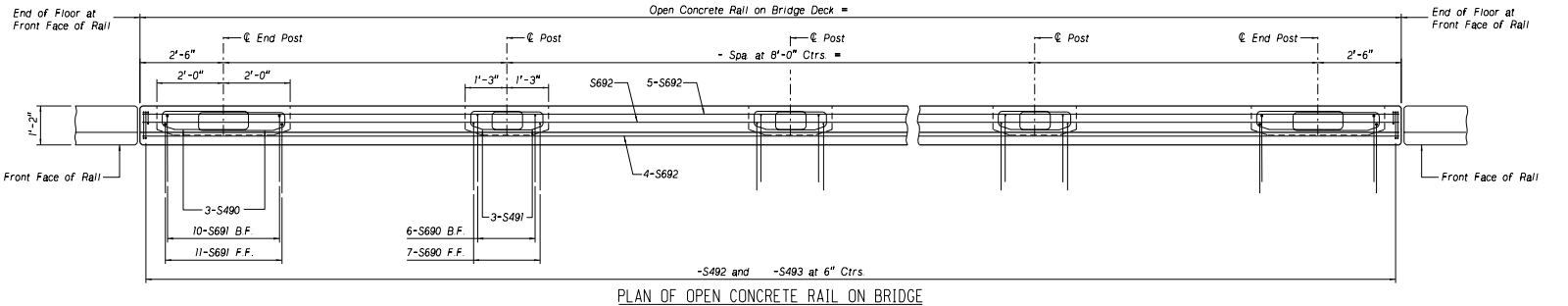
Nebraska

SPECIAL PLAN NO.

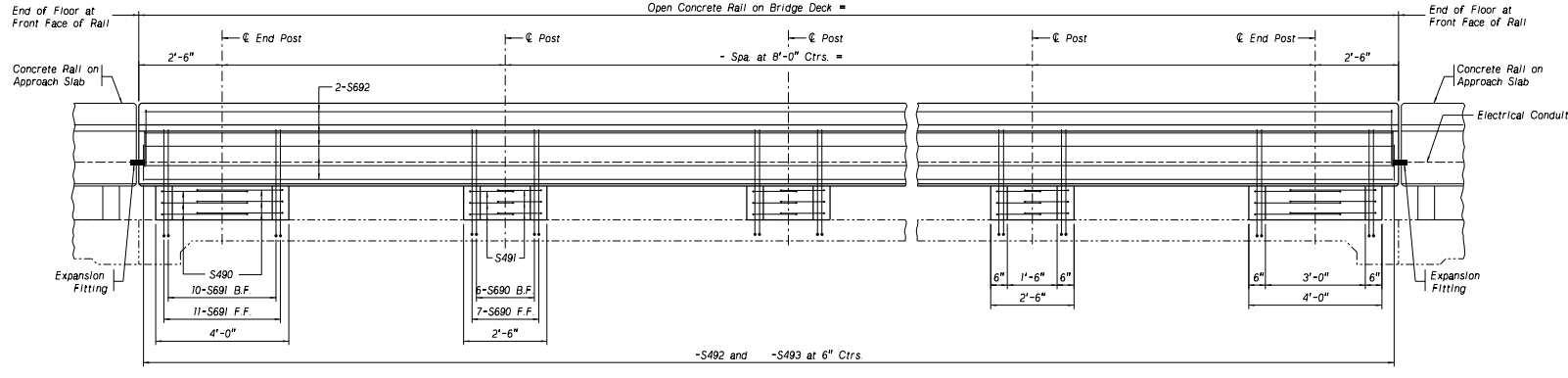
Sept. 12 2004

Sheet

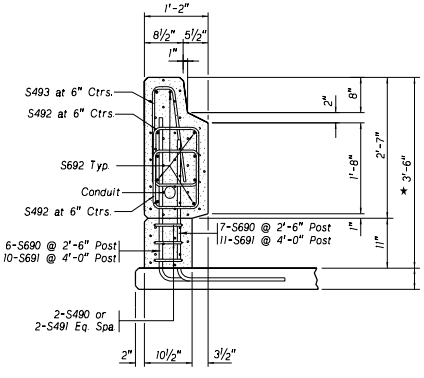
6.5.3.3.1



PLAN OF OPEN CONCRETE RAIL ON BRIDGE



ELEVATION OF OPEN CONCRETE RAIL ON BRIDGE



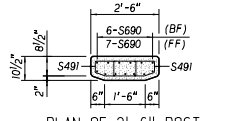
TYPICAL SECTION OF RAIL

NOTES:

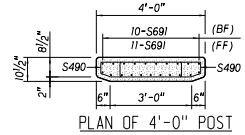
Posts must be plumb.

★ Measured at front face of rail.

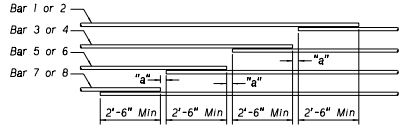
For Bill of Bars see sheet of .



PLAN OF 2'-6" POST

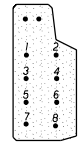


PLAN OF 4'-0" POST



"a" ≥ Zero

LAP DETAIL



RAIL SECTION
See Lap Detail

PROJECT NUMBER

SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

OPEN CONCRETE RAIL ON BRIDGE DECK

DESIGNED BY
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REF. POST.
STA.

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

Nebraska

SPECIAL PLAN NO.

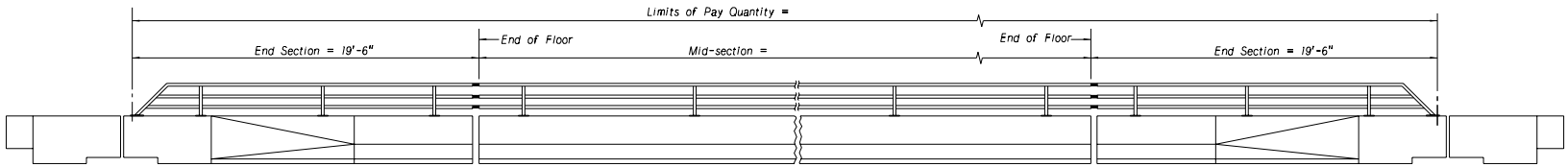
6.5.3.3.2

NURAIL1.DGN

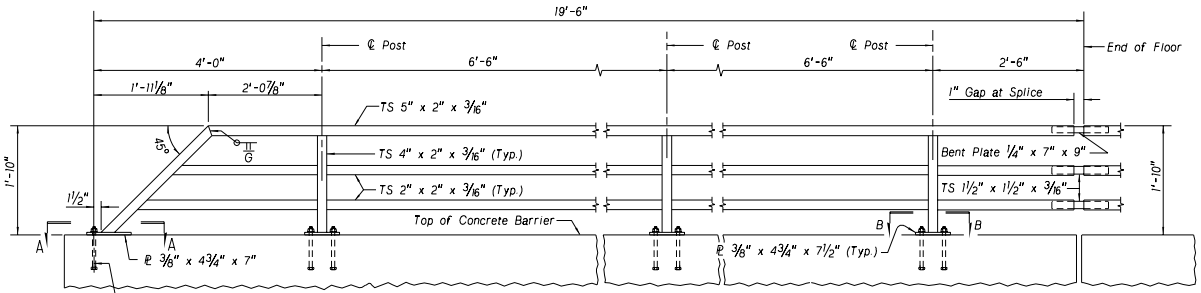
June 7, 2005

Sheet D

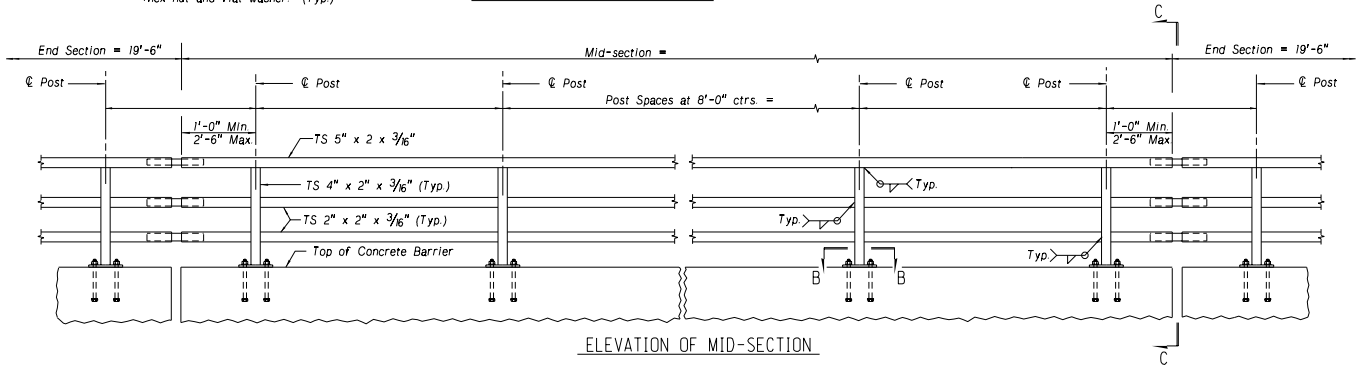
PEDRALCTE.DGN



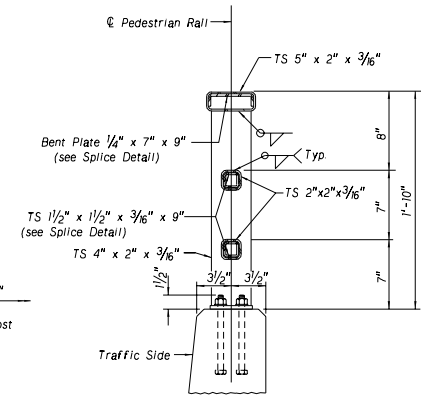
PEDESTRIAN BARRIER RAIL LAYOUT



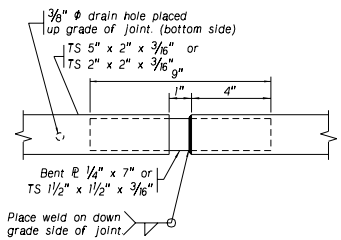
ELEVATION OF END SECTION



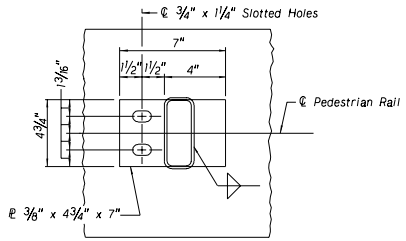
ELEVATION OF MID-SECTION



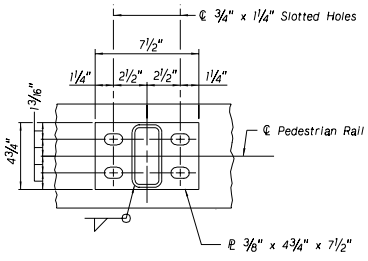
TYPICAL POST DETAIL AND SECTION C-C



SPLICE DETAIL
Plan View



SECTION A-A



SECTION B-B

NOTES

All dimensions are measured along ℄ rail.

Structural tubing for the pedestrian barrier rail shall conform to the requirements of ASTM A500 grade B. All structural steel for pedestrian barrier rail shall be galvanized after fabrication, according to the requirements of ASTM A123. Anchor bolts and hardware shall be galvanized according to the requirements of ASTM A153.

Pedestrian barrier rail posts shall be set plumb. Structural tubing for pedestrian barrier rail shall have a minimum length of 20'-0" and a maximum length of 40'-0" between splices. Splices shall be placed within 2'-6" of ℄ posts. All areas of pedestrian barrier rail fabrication which can retain water shall be provided with a 3/8" ϕ drain hole.

PROJECT NUMBER	SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

DATE

CHECKED BY

DETAILED BY

DESIGNED BY

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

COUNTY
HWY. NO.
REF. POST.
STA.

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

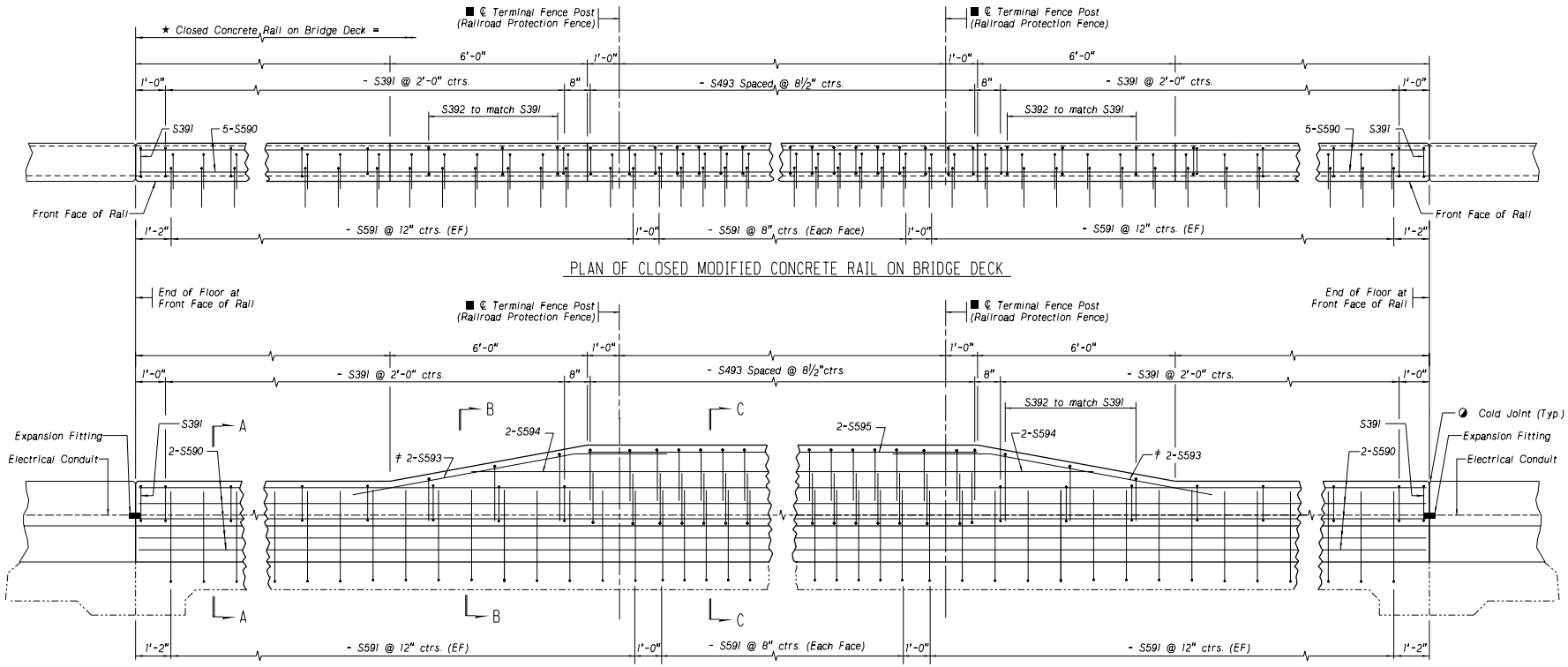
SPECIAL PLAN NO.

6.5.10

Sheet B

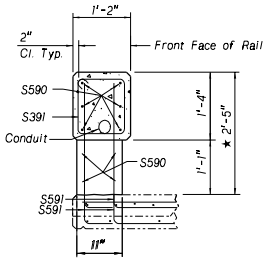
* Shown on this page

*LEVEL 50 = Bridge Deck on Gerders
LEVEL 51 = Concrete Slab Bridge Deck
LEVEL 52 = Bridge Deck on Double Tee
*LEVEL 53 = Lighting Details

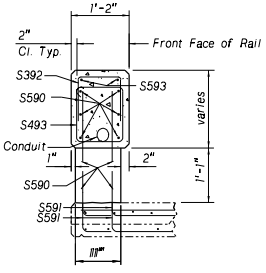


PLAN OF CLOSED MODIFIED CONCRETE RAIL ON BRIDGE DECK

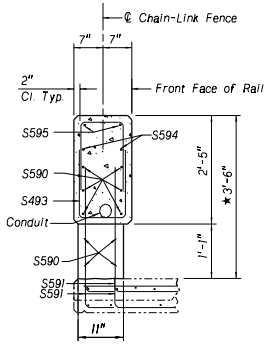
ELEVATION OF CLOSED MODIFIED CONCRETE RAIL ON BRIDGE DECK



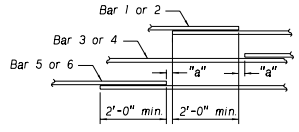
SECTION A-A



SECTION B-B



SECTION C-C



▲LAP DETAIL

▲ Laps for Bars 1 and 5 shall be staggered.
Laps for Bars 2 and 6 shall be staggered.
Bar 3 to be continuous through laps for Bars 1 and 5
Bar 4 to be continuous through laps for Bars 2 and 6
"a" ≥ Zero

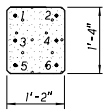
◕ When pouring concrete rails, a mandatory chamfered cold joint must be formed at the end of floor.

NOTES:

★ Measured at front face of rail

Field Bend to clear Transition.

■ For details and post spacing of the Railroad Protection Fence see sheet of .



RAIL SECTION
See Lap Detail

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

DESIGNED BY
DETAILED BY
CHECKED BY
DATE

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
REV. POST.
STA.
HWY. NO.
COUNTY

Nebraska

SPECIAL PLAN NO.

6.5.11

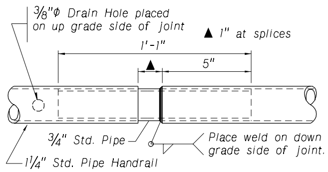
UPRRCTE3.DGN

February 12, 2004

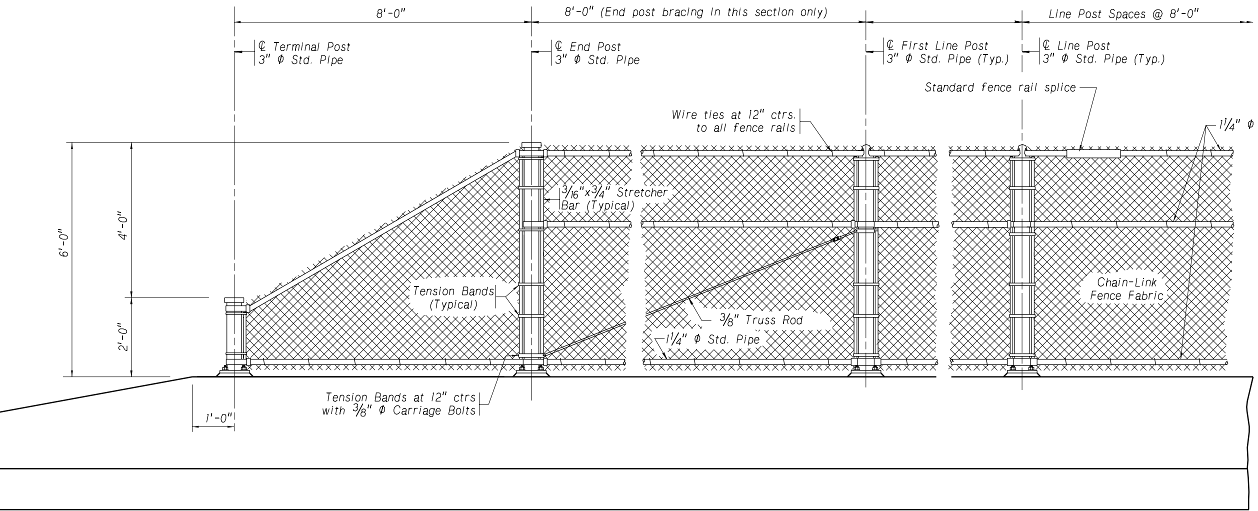
Sheet 4

✻ Shown on this page

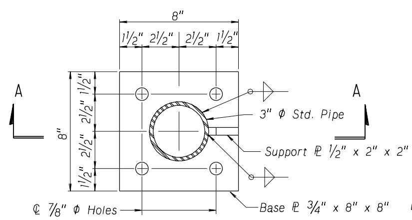
✻ LEVEL 54 = Galvanized coating
✻ LEVEL 55 = Vinyl Coated - Dark Brown
✻ LEVEL 56= Vinyl Coated - Black



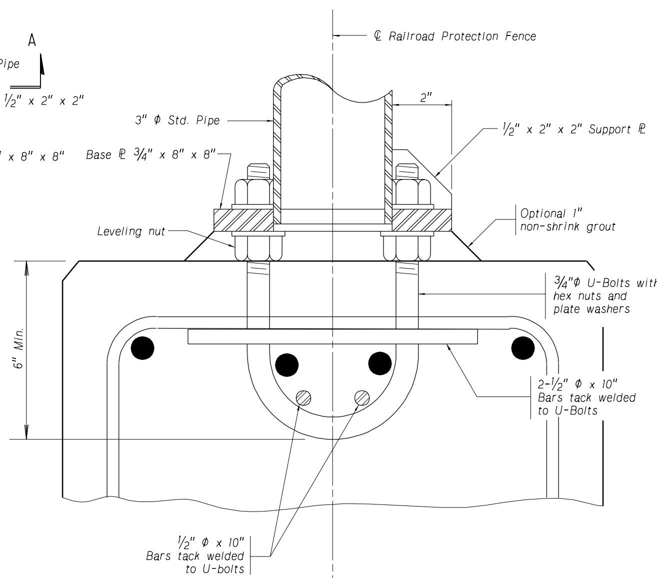
EXPANSION JOINT and SPLICE DETAIL
(Plan View)



ELEVATION SHOWING RAILROAD PROTECTION FENCE



BASE PLATE PLAN VIEW



SECTION A-A

NOTES

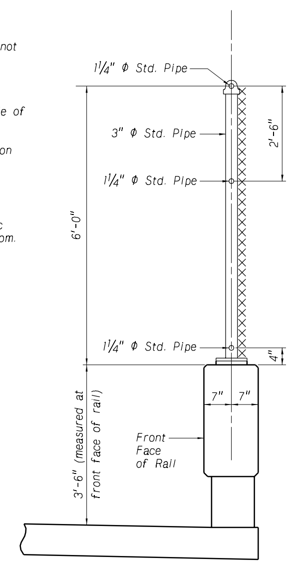
All standard pipe sizes indicate Nominal Pipe Sizes (NPS). NPS does not refer to the actual inside or outside diameter of the pipe.

Fence layout shall conform to vertical alignment of the bridge.

Fence posts shall be set plumb. All nuts shall be placed on the outside of the fence. Peen 3/8" bolts.

Fence rails must have expansion joints placed at each roadway expansion device.

Chain-Link fence and handrail will be vinyl coated and conform to the requirements of Section 1064 of the Standard Specifications.
Chain-Link fence will be galvanized and conform to the requirements of Section 1064 of the Standard Specifications.
The coating will be black and industrial grade. The height of the fabric shall be 6'-0". Knuckled selvage shall be provided at the top and bottom.
The coating will be dark brown and industrial grade. The height of fabric shall be 6'-0". Knuckled selvage shall be provided at the top and bottom.
The height of the fabric shall be 6'-0". Knuckled selvage shall be provided at the top and bottom.

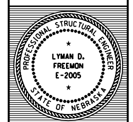


TYPICAL SECTION THROUGH RAIL & FENCE

PROJECT NUMBER | SHEET NO.

C.N.

STRUCTURE NUMBER



BRIDGE ENGINEER

COUNTY
HWY. NO.
REF. POST.
STA.

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD

DESIGNED BY | DETAILED BY | CHECKED BY | DATE

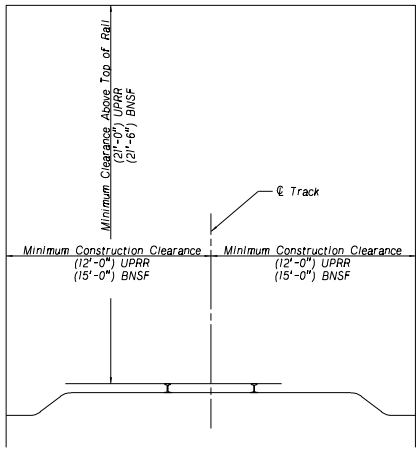
STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

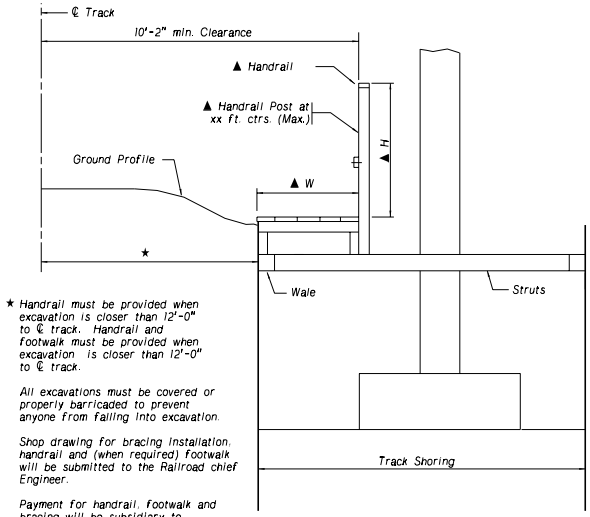
SPECIAL PLAN NO.

February 12, 2004

RRCTE.DGN



MINIMUM CONSTRUCTION CLEARANCES



★ Handrail must be provided when excavation is closer than 12'-0" to ℄ track. Handrail and footwalk must be provided when excavation is closer than 12'-0" to ℄ track.

All excavations must be covered or properly barricaded to prevent anyone from falling into excavation.

Shop drawing for bracing installation, handrail and (when required) footwalk will be submitted to the Railroad chief Engineer.

Payment for handrail, footwalk and bracing will be subsidiary to payment for Pier Excavation.

▲ Handrail and Footwalk dimensions shall conform to OSHA requirements.

TRACK PROTECTION SHORING REQUIREMENTS

TRACK PROTECTION SHORING.
All dimensions are measured perpendicular to ℄ Track.

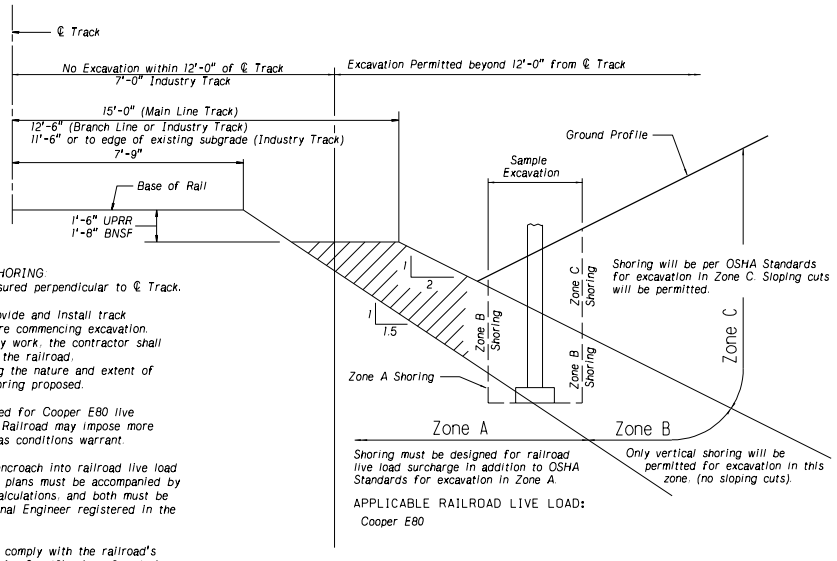
The contractor shall provide and install track protection shoring before commencing excavation. Prior to commencing any work, the contractor shall submit for approval by the railroad, detailed plans indicating the nature and extent of the track protection shoring proposed.

Shoring shall be designed for Cooper E80 live load surcharge and the Railroad may impose more stringent requirements as conditions warrant.

For excavations which encroach into railroad live load surcharge zone, shoring plans must be accompanied by a copy of the design calculations, and both must be stamped by a Professional Engineer registered in the state of Nebraska.

Design of shoring shall comply with the railroad's guidelines and A.R.E.M.A. Specifications for design and construction of shoring adjacent to active railroad tracks.

Direct payment will not be made for this work, but shall be considered subsidiary to the Pier Excavation.



APPLICABLE RAILROAD LIVE LOAD:
Cooper E80

TRACK PROTECTION SHORING REQUIREMENTS

PROJECT NUMBER	SHEET NO.

C.N.
STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
CHECKED BY
DATE

COUNTY
HWY. NO.
REP. POST.
STA.
DESIGNED BY

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Nebraska

SPECIAL PLAN NO.

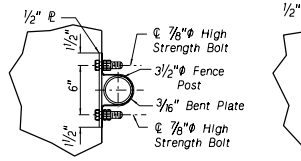
9.5.1.13

Sheet A

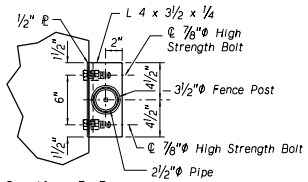
Railfence.dgn

Feb. 12, 2004

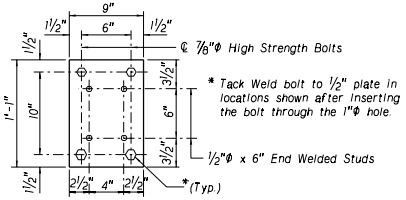
Sheet 5



Section A-A



Section B-B



Section B-B
(½" ℄)

NOTES

All 3½"Φ and 2"Φ steel pipe shall conform to the requirements of A.S.T.M. A-53, Grade B.

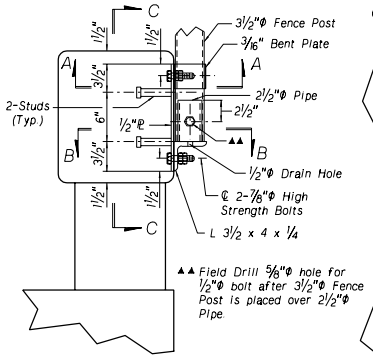
All 1¼"Φ steel pipe shall conform to the requirements of A.S.T.M. A-53, Grade F.

Material for railing assembly, after fabrication, shall be galvanized according to the requirements of A.S.T.M. A-123. Anchor bolts and hardware shall be galvanized according to the requirements of A.S.T.M. A-153.

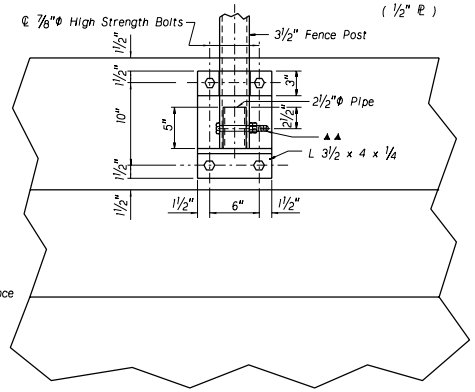
Chain-Link fence fabric shall conform to the requirements of A.S.T.M. A-392. The fabric shall be 7'-0" in height, No. 9 gauge wire, 2" mesh, zinc coated after weaving with class 2 coating, and shall have knuckled selvage top and bottom.

Railing shall conform to vertical alignment of the Bridge, posts shall be set plumb. Fabric shall be installed parallel to bridge floor.

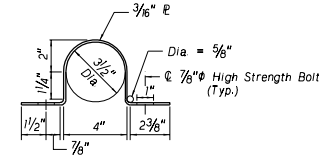
All nuts shall be placed on the outside of the fence. Peen all 3/16"Φ Bolts.



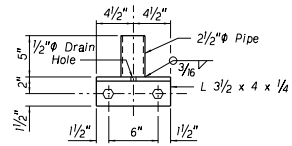
Section of Fence Attachment to Concrete Rail



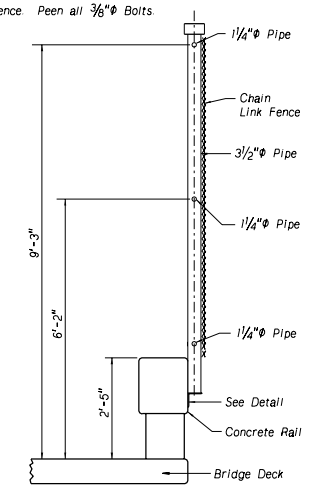
Elevation of Fence Attachment to Back of Concrete



Plan View of Bent Plate



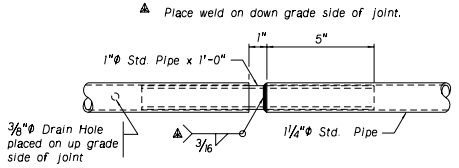
Elevation of Angle and Pipe



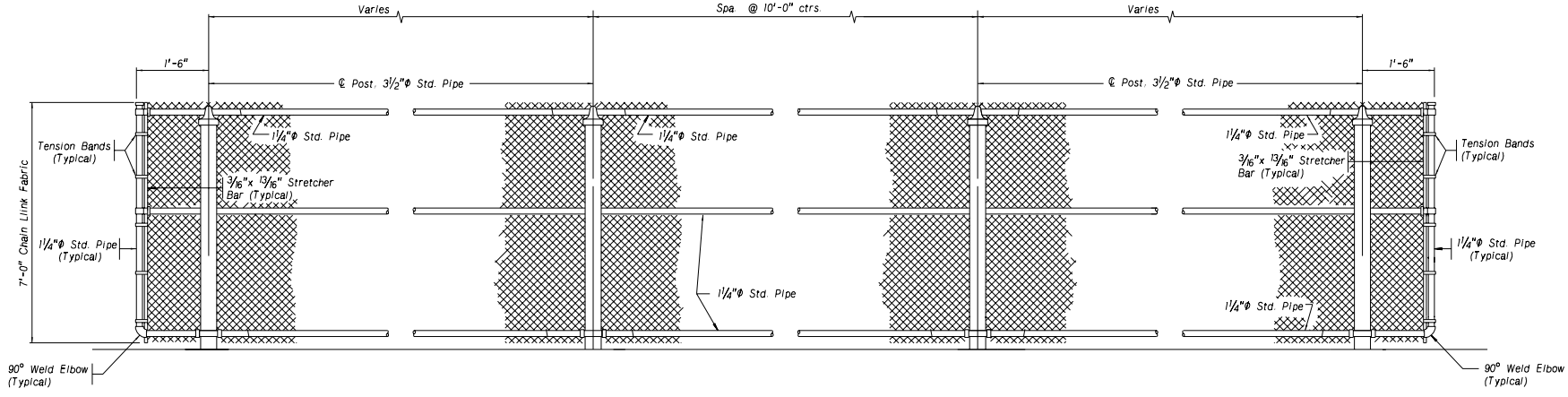
SECTION OF CHAIN LINK FENCE

DETAILS FOR FENCE ATTACHMENT TO CONCRETE RAIL

Not to Scale



EXPANSION JOINT DETAILS



NOTE For Chain Link Fence location see sheet of .

ELEVATION OF CHAIN LINK FENCE

Not to Scale

PROJECT NUMBER	SHEET NO.

C.N.

STRUCTURE NUMBER

PROFESSIONAL STRUCTURAL ENGINEER
LYMAN D. FREEMON
E-2005
STATE OF NEBRASKA

BRIDGE ENGINEER

STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

Fence Details at Rail

LOCATION
SKEW
ROADWAY
DESIGN LIVE LOAD
DETAILED BY
DESIGNED BY
CHECKED BY
DATE
COUNTY
HWY. NO.
REF. POST.
STA.

Nebraska

SPECIAL PLAN NO.

6.5.1.4